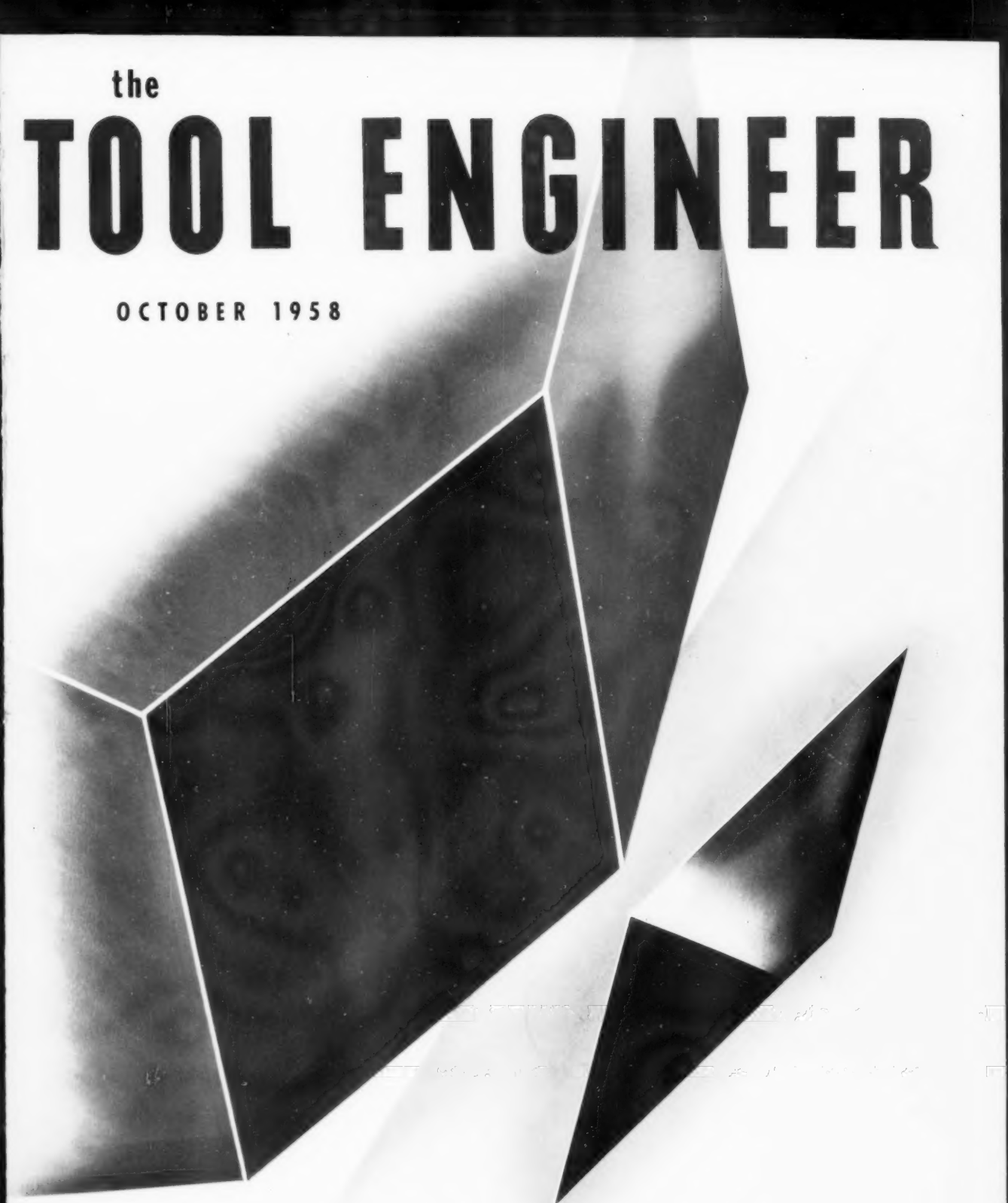
the TOOL ENGINEER

OCTOBER 1958



microhardness testing

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

it's mainly a matter of TIMING!

Q. *WHEN should you replace a machine?*

A. *When you can do it at a PROFIT!*

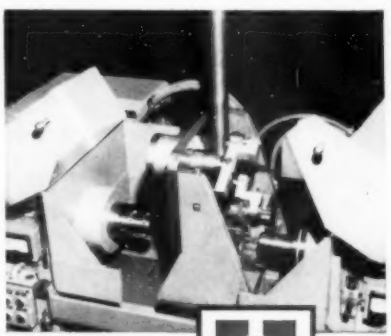
Obsolescence is an insidious thing. It can overtake any machine—even a relatively new one—without warning. And when it does, you're producing at a *loss.*

The only way to catch it in *time* is to make frequent studies, comparing the production cost of the old machine with that of the new one that might replace it. Then weigh these costs in terms of investment and return. Up to a certain point, the old machine will still be profitable to operate. Beyond that point, it's running *in the red.*

Heald sales engineers are well experienced in precise methods of replacement analysis. And they will be glad to help you determine when you can replace an existing machine *at a profit.* Similar cost studies by Heald engineers have pointed the way to many important cost savings.

For example: This new Heald Model 322 Bore-Matic replaced a heavy-duty drill for boring and chamfering hydraulic-cylinder piston rods. A cost analysis determined that the investment in a new machine could not be deferred any longer without serious financial loss. As verified by subsequent operation, the new machine offered the following savings:

	Old Machine	New Machine
Parts per hour	11	24
Machine load, per year	3,080 hrs.	1,380 hrs.
Direct & Indirect Labor	9,480 hrs.	3,240 hrs.
Annual Maintenance	$356	$100
Annual Operating Cost	$27,800	$15,000
Annual Saving, New Machine		$12,800
Net Return on Investment		39.6%



YOU pay for obsolescence. Replacement pays for itself!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

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the tool engineer

Vol. 41, No. 4 October 1958

Ultrahigh-Speed Machining—Solution to Producibility Problems? ..... *By Robert L. Vaughn* 71
Experiments at Lockheed have included firing a hardened slug so that it grazes a cutting tool at 180,000 fpm.

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Wire-straightening device . . . steel stamp hammer . . . milling clamp for irregular workpieces . . . thread tool setting gage.

Yardstick for Machine Replacement ..... *By B. A. Margo* 80
An objective method facilitates planning machine replacement programs so that there is an optimum return on investment

Numerical Control for the Small Shop ..... *By A. F. Brewer and H. W. Beckwith* 83
Productivity of drilling operations can be increased from two to nine times with a relatively simple automatic control system.

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Testing the hardness of small parts of thin materials can be quickly and efficiently accomplished with modern equipment.

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Chipless machining is possible with this process, which forms parts to close tolerances by rotary extrusion.

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Research projects are hindered by the absence of standard methods for accumulating and reporting results. A solution is offered.

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When the special requirements of the extrusion process are understood, parts can be designed for more efficient manufacture.

Effects of Operating Variables on Abrasive-Belt Life ..... *By J. M. Pitblado* 113
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Rapid Evaluation of Cutting Tools ..... *By L. B. Zylstra* 117
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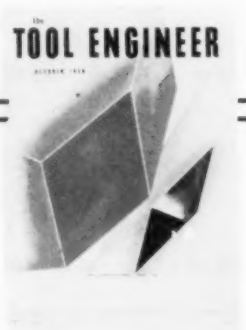
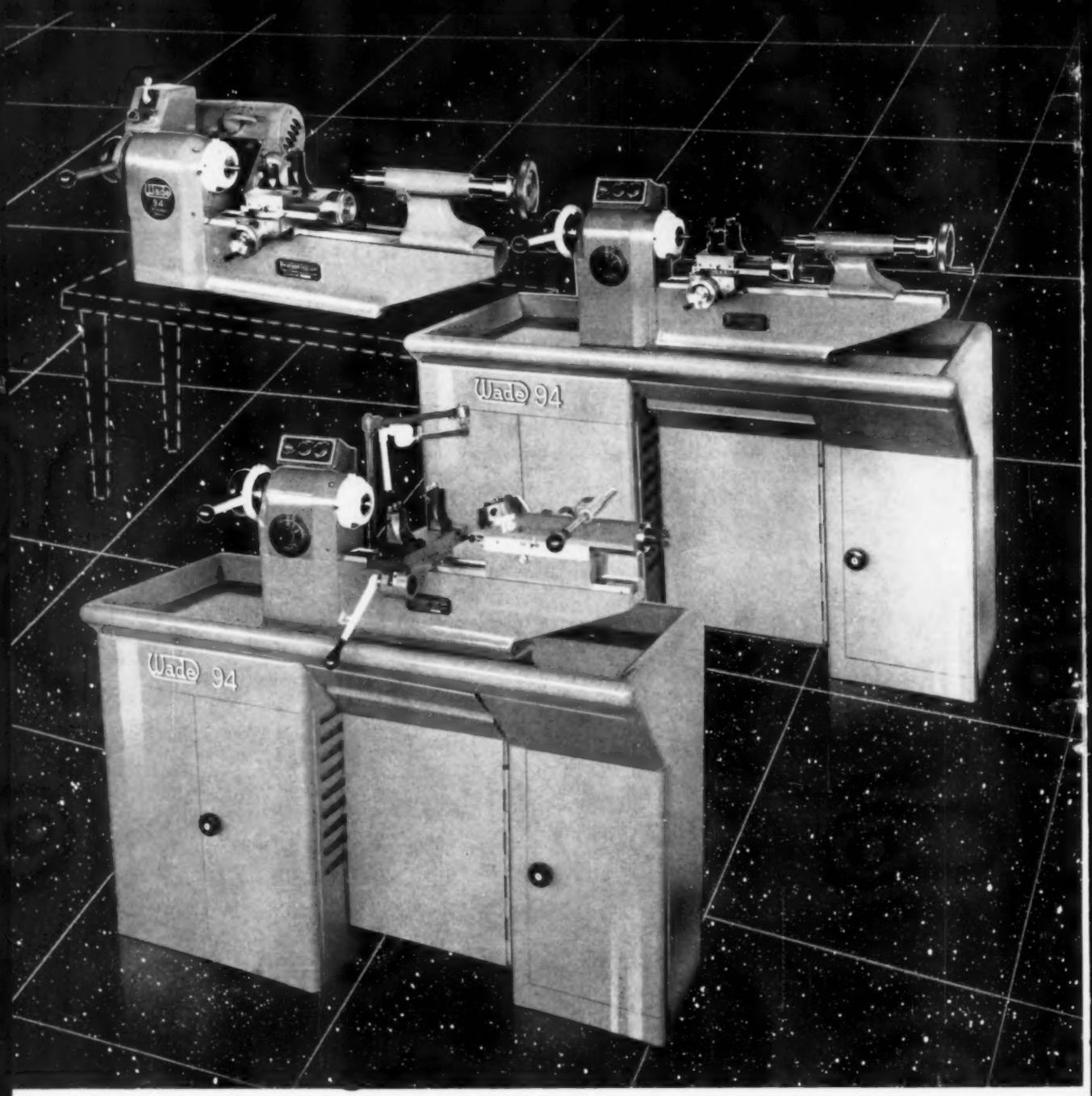
THIS MONTH'S COVER



Diamond indenters are used in microhardness testing. Here the indenter has just completed its work. Hardness is determined by measuring the distance across the indentation. Further details are given in an article beginning on page 87. William Solms is the cover artist.

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Industrial Arts Index*.



Here are three new high-precision PRODUCTION MACHINES to give you

- more production
- more accurate work
- finer finish, and
- lower cost

(*Top*) WADE 94 Utility Lathe (*Middle*) WADE 94 Finishing Lathe (*Bottom*) WADE 94 Electric Clutch Hand Turret Lathe

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Seeds of Progress

With business on the upturn, management is again turning attention to more effective methods and equipment for building a better product. Expositions, such as the Western Tool Show at Los Angeles, do their part in stimulating the adoption of improved production processing. Creative thinking receives a shot in the arm because ideas are generated when one sees new equipment and how others are doing the job. The remaining hurdle is the necessary confidence in the future to plan and install the needed machines.

That our economy is on the upswing is verified by most of the indexes of our "leading indicators." Manufacturers' orders for materials continue to increase; the trend started in February. Steel production, as an example, is increasing steadily.

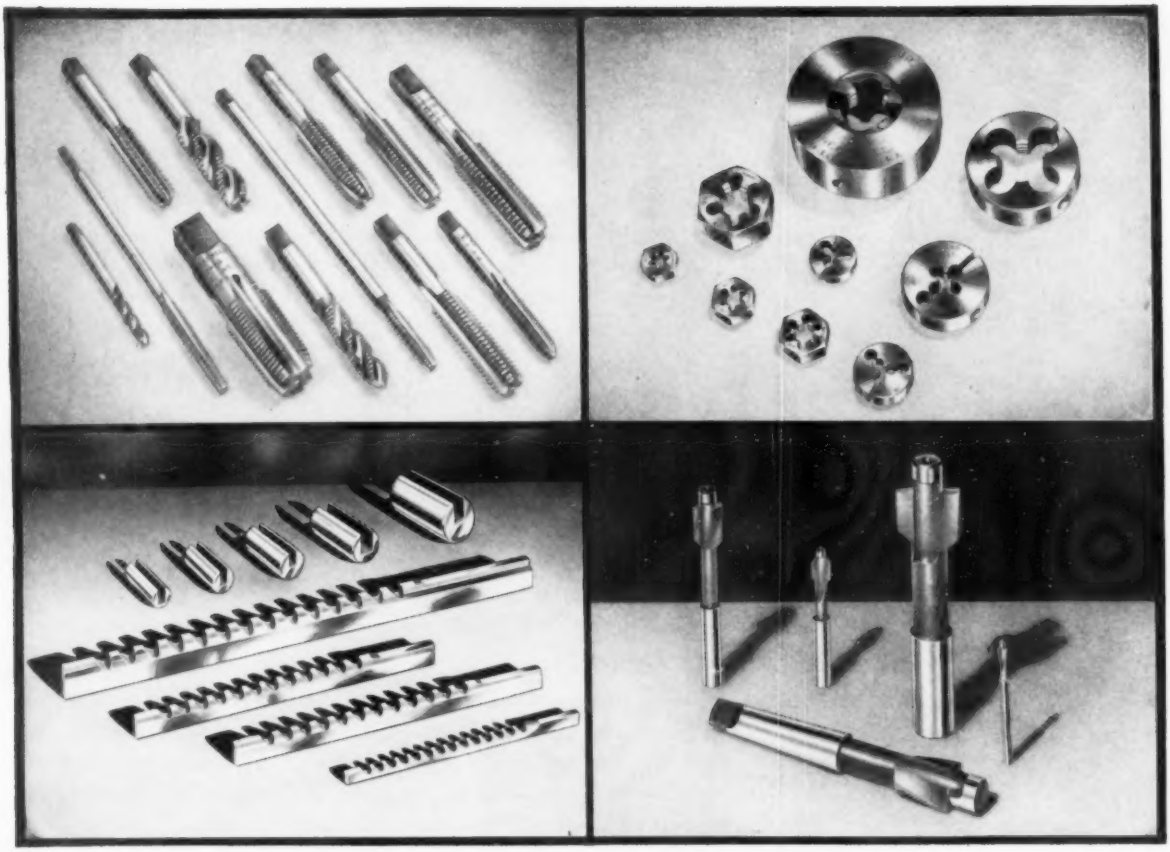
As usual there are a few indexes that do not support the upswing trend. For instance, investment in business capital has not yet shown this trend. Also, unemployment still remains high. With respect to the latter, figures are difficult to evaluate. Nevertheless, as the work-force grows each year through population increases, the consumer demand and potential market for goods grow at faster rates.

Proper use of new equipment requires more than confidence. It involves the availability of improved machines. Also, it requires the ability and imagination of the tool engineer to recognize the potential application of a specific machine and to apply it properly. Without this combination to put the machine in its place, its development would be futile.

Machine improvement implies that the machine will do a better job than its predecessor either precisionwise or quantitywise with reduced effort and time on the part of the operator. With tools of this type the tool engineer can continue to make our production achievements the wonder of the world.

John W Greve

EDITOR



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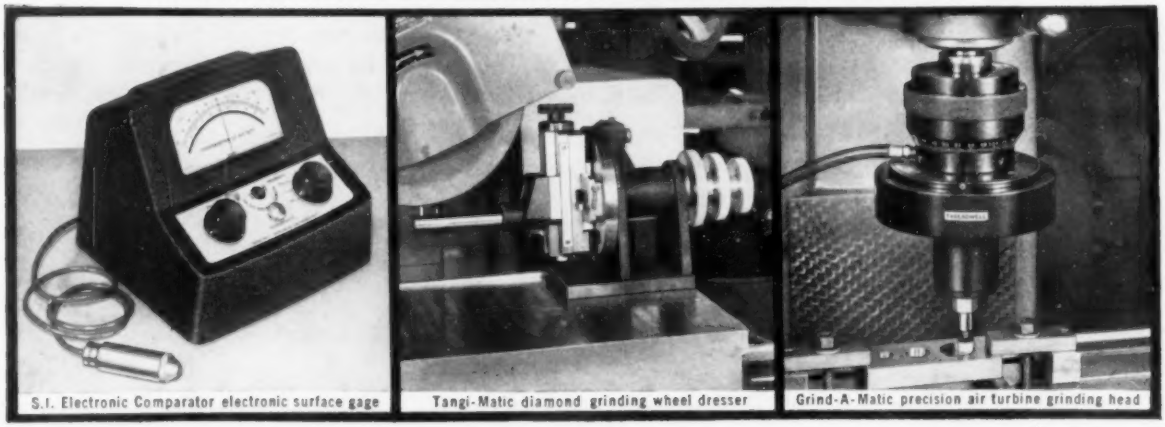

S.I. Electronic Comparator electronic surface gage

Tangi-Matic diamond grinding wheel dresser

Grind-A-Matic precision air turbine grinding head

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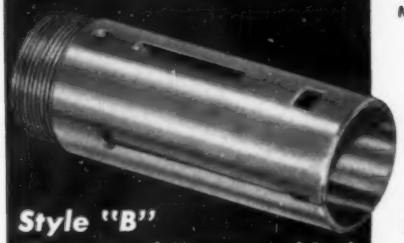
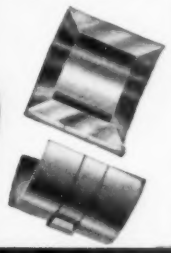


Style "B"
Master Feed Fingers and Pads



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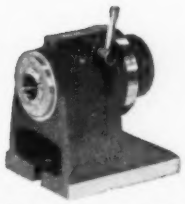
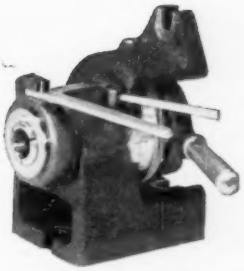
Write for Style "S" Bulletin Style "B" Bulletin



H-4 Tool Room-Inspection



HV-4 Production

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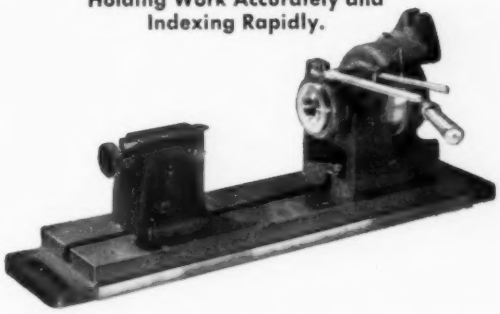

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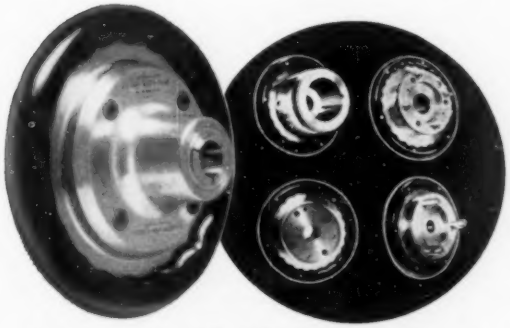
Speed
COLLET CHUCKS

Fast — Accurate
Increase Production Capacity



Available in 1 1/16"; 1 3/8"; 2 1/4"; and 3 1/2" collet capacity. Threaded nose, cam lock, tapered key-drive and American Standard spindles. *Write for Bulletin 8A.*

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Write for Bulletin 56 —
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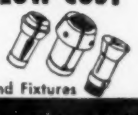
information for all Lathes, Millers, Grinders and Fixtures



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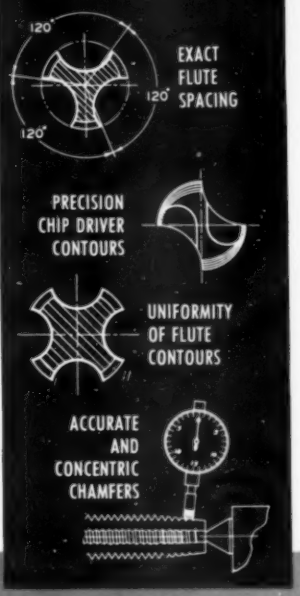

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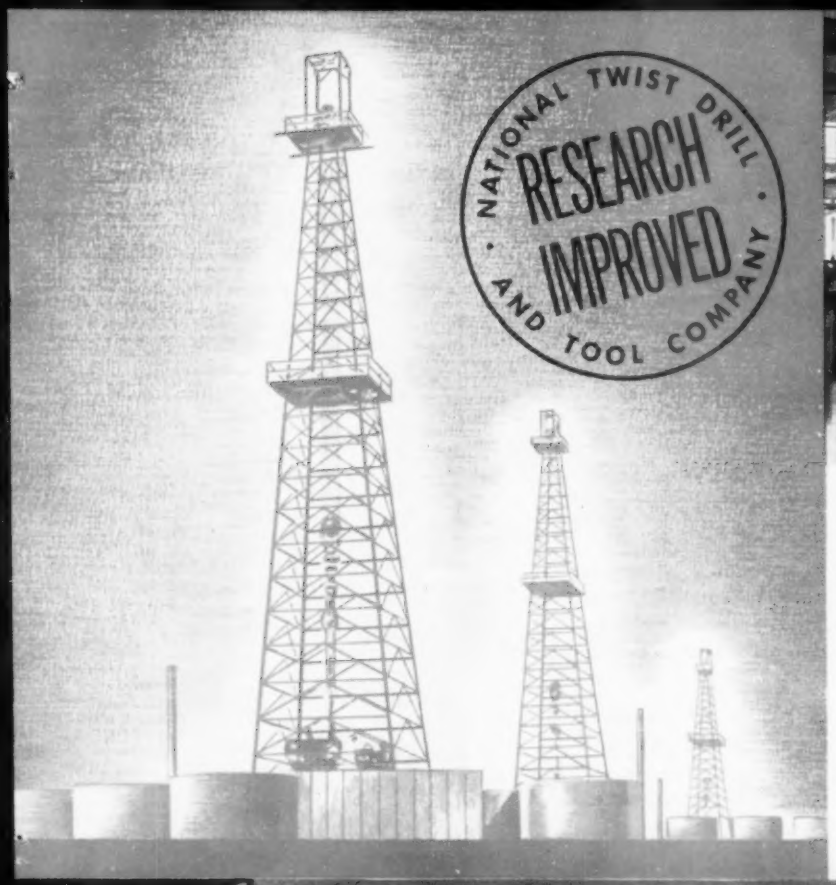
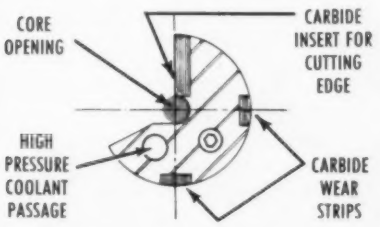
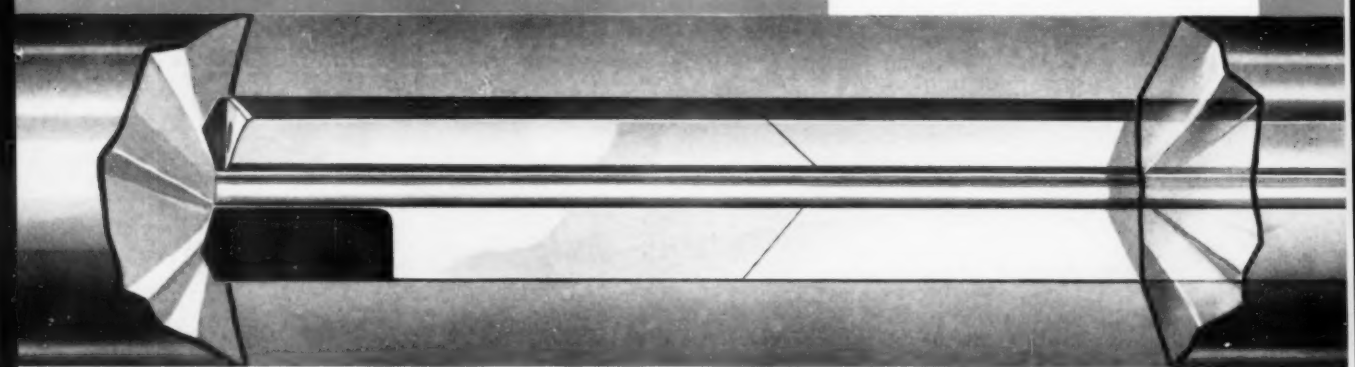


The National Target Gun Drill above is 22 feet long, has no dead center, no zero speed area. Instead, it uses the solid core as a continuous center guide for the drill, producing a straight, true hole with good finish in a single operation.





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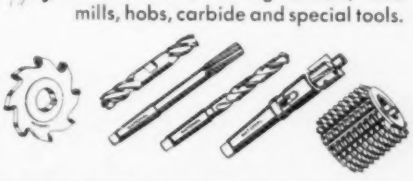

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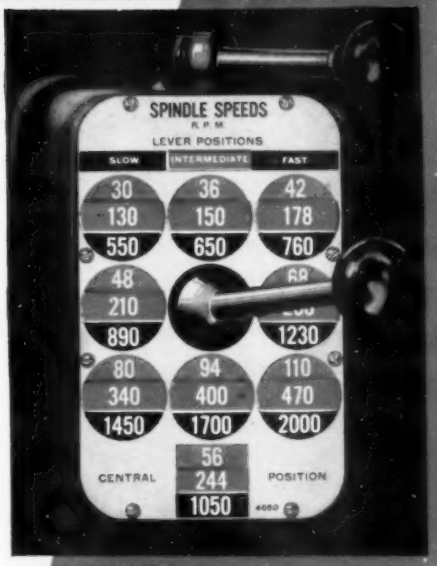
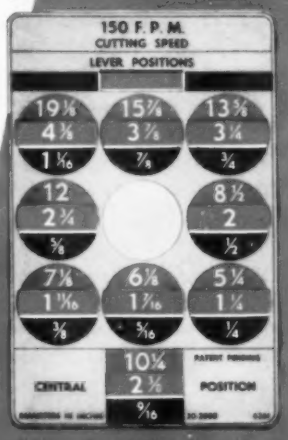
- *These and other fine features of the "AMERICAN" DeLuxe Model Pacemaker are illustrated and described by Bulletin No. 116.*



Spindle Speed Plate (Direct Reading)



Cutting Speed Plate (Direct Reading)

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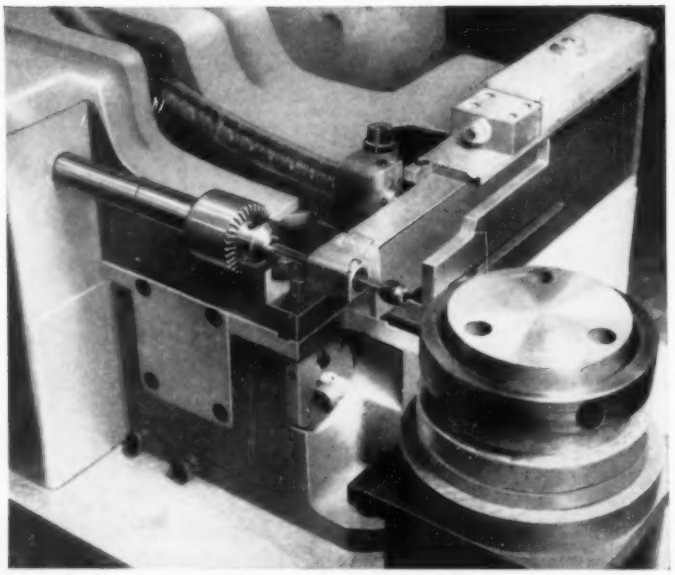

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#5	9	7.8	7.4	15
#6	9	7.8	7.4	15
#8	20	14.7	14.5	36
#10	33	26.5	25	25
¼	87	62	60	40
5/16	165	122	125	32
3/8	290	198	225	29
7/16	430	309	350	23
½	620	460	500	24
5/8	1225	1106	1060	11
3/4	2125	1540	1800	18
7/8	5000	3660	4600	9
1	7000	5025	6500	8

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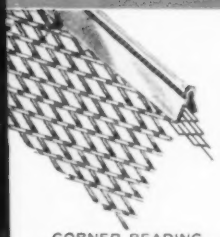
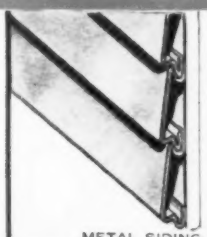
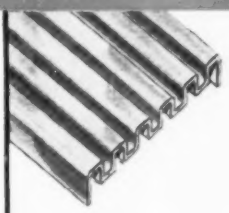
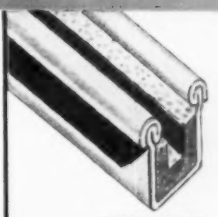
The Shapes of Things to Come

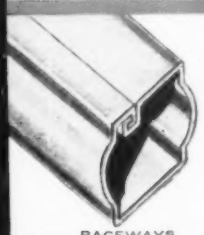

CORNER BEADING

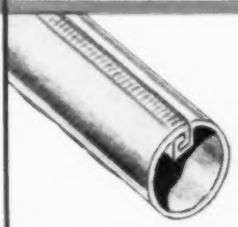

METAL SIDING

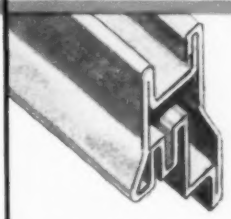

METAL DECK—FLUTING

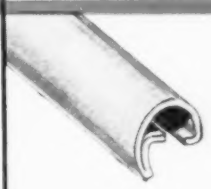
STAINLESS—GALVANIZED TRIM

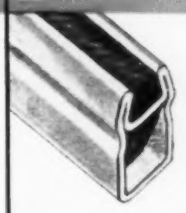

AUTOMOTIVE WEATHERSTRIP


RACEWAYS

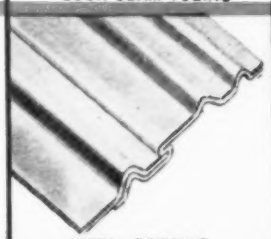

LOCK SEAM TUBING

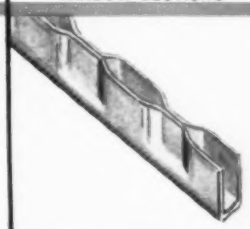

WINDOW SECTIONS

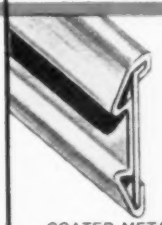

MOULDING

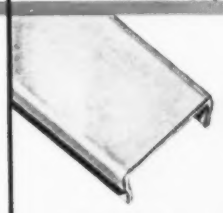

NAILING FLANGES

LOCK SEAM BOX SECTIONS


METAL ROOFING


IRREGULAR PATTERNS


COATED METAL PRICE STRIPS


SHEET and STRIP FLANGING

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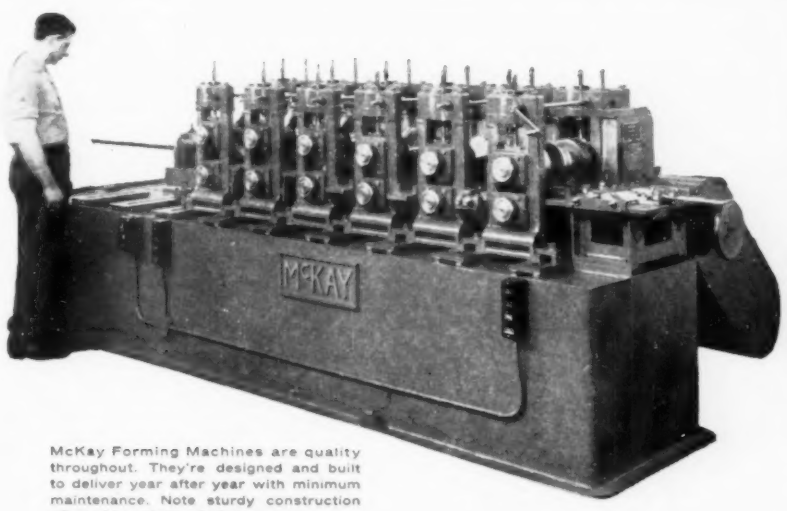
Two words that best describe McKay Forming Machines are "precision" and "ruggedness."

McKay Forming Machines are the last word in quality. They're designed and built to perform with extreme accuracy year after year. McKay users the world over know that quality is never sacrificed, even in the smallest details, for the sake of marketing a "cheaper" unit.

And McKay Forming Machines are built to customers' requirements with an eye to the future. They're machines that will not only meet today's needs, but machines that are ready for the faster speeds, tougher metals and more intricate shapes of tomorrow.

Be sure you have checked with McKay before you order forming equipment. You'll find this unmatched precision and ruggedness pays off in better forming at greatly reduced costs. And with a McKay—you're ready for tomorrow!



McKay Forming Machines are quality throughout. They're designed and built to deliver year after year with minimum maintenance. Note sturdy construction of machine pictured above.

The McKAY MACHINE Company
YOUNGSTOWN, OHIO

McK

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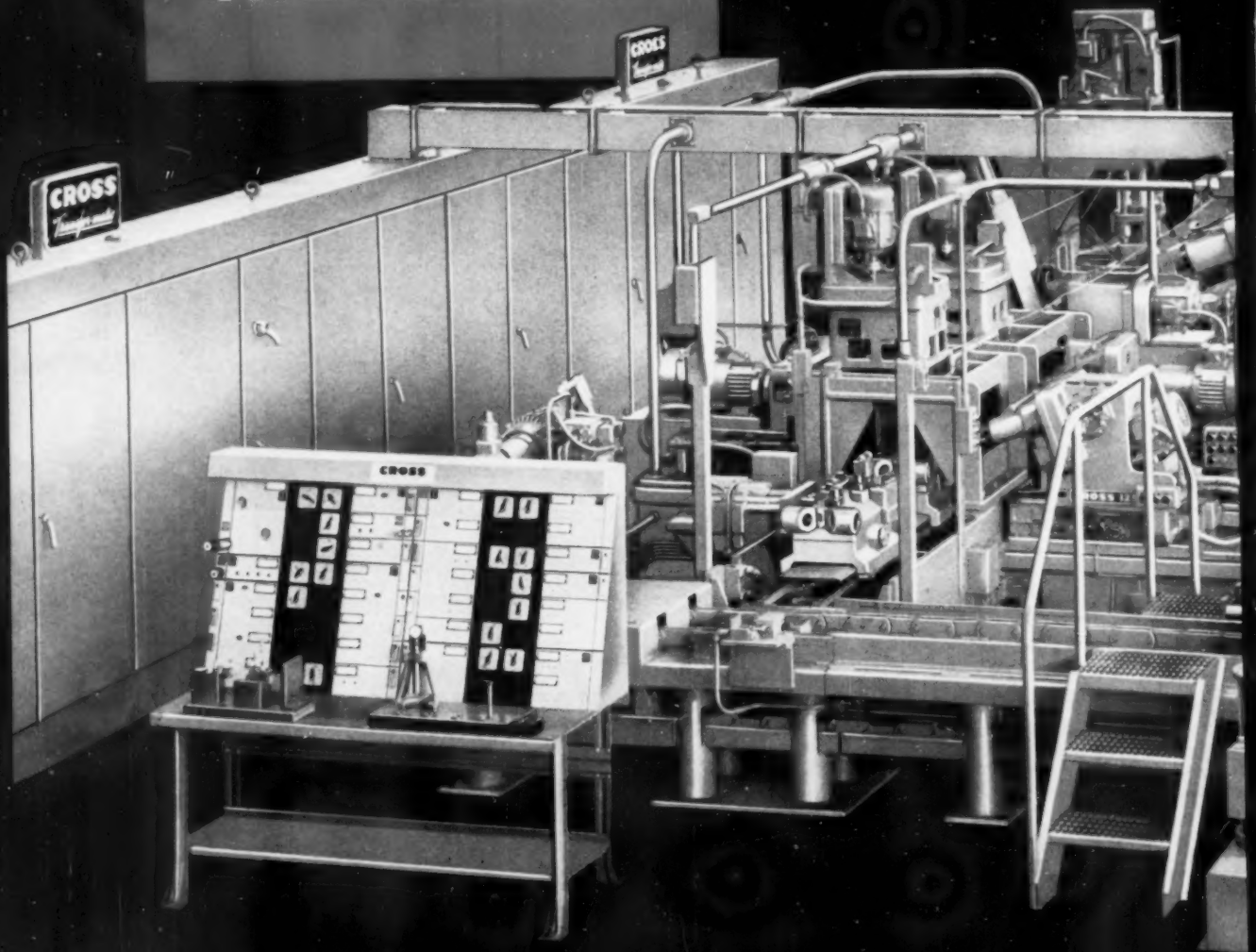
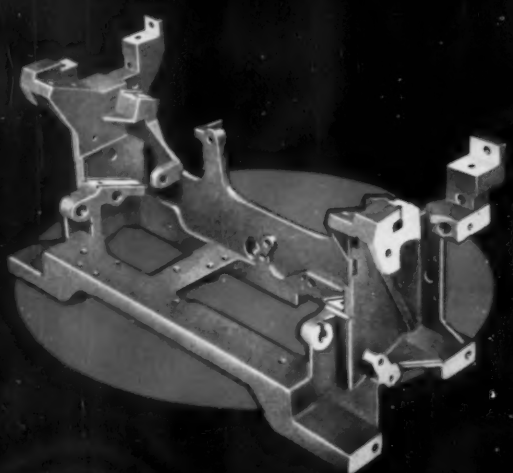
Completely Machines Aluminum Typewriter Frames





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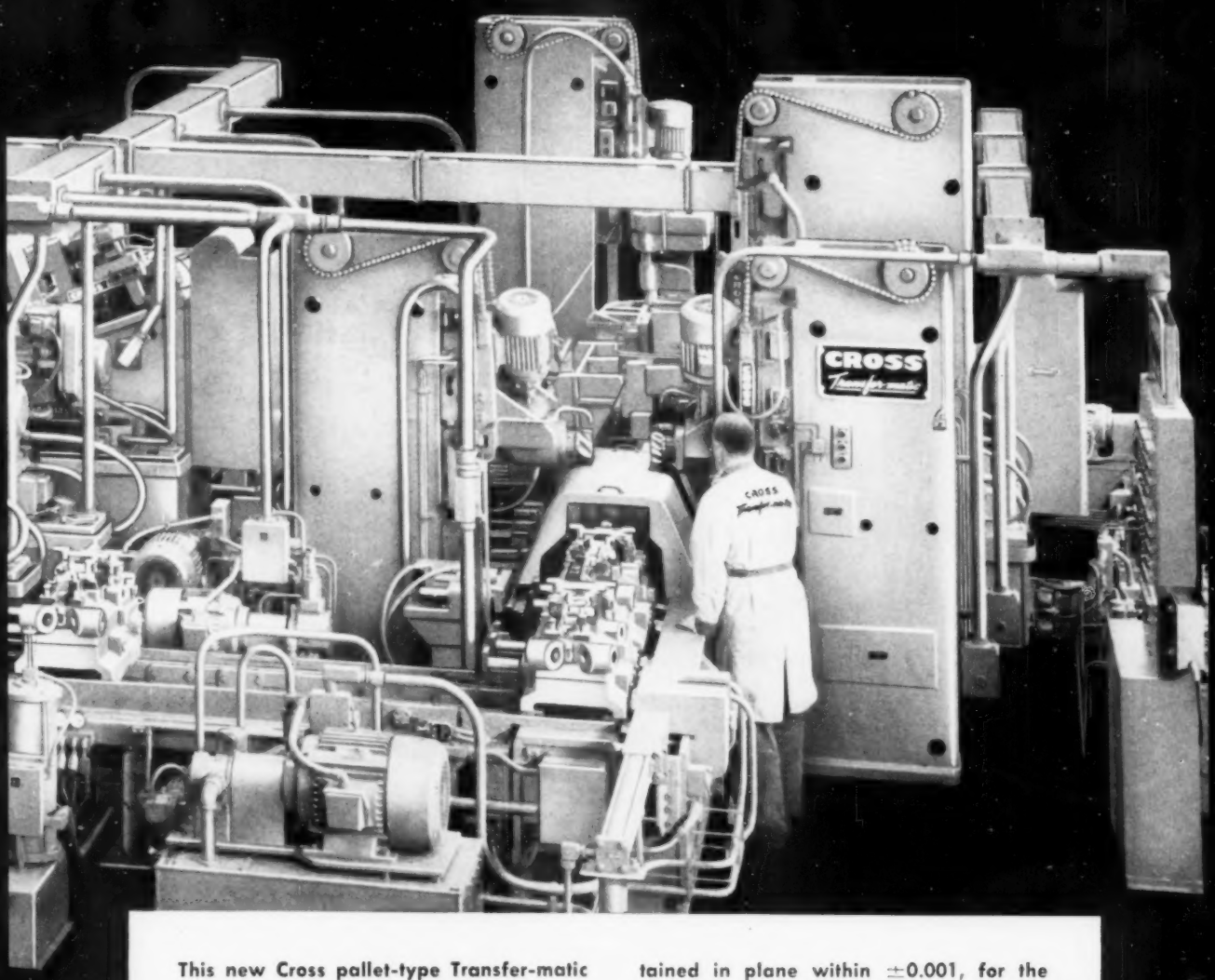


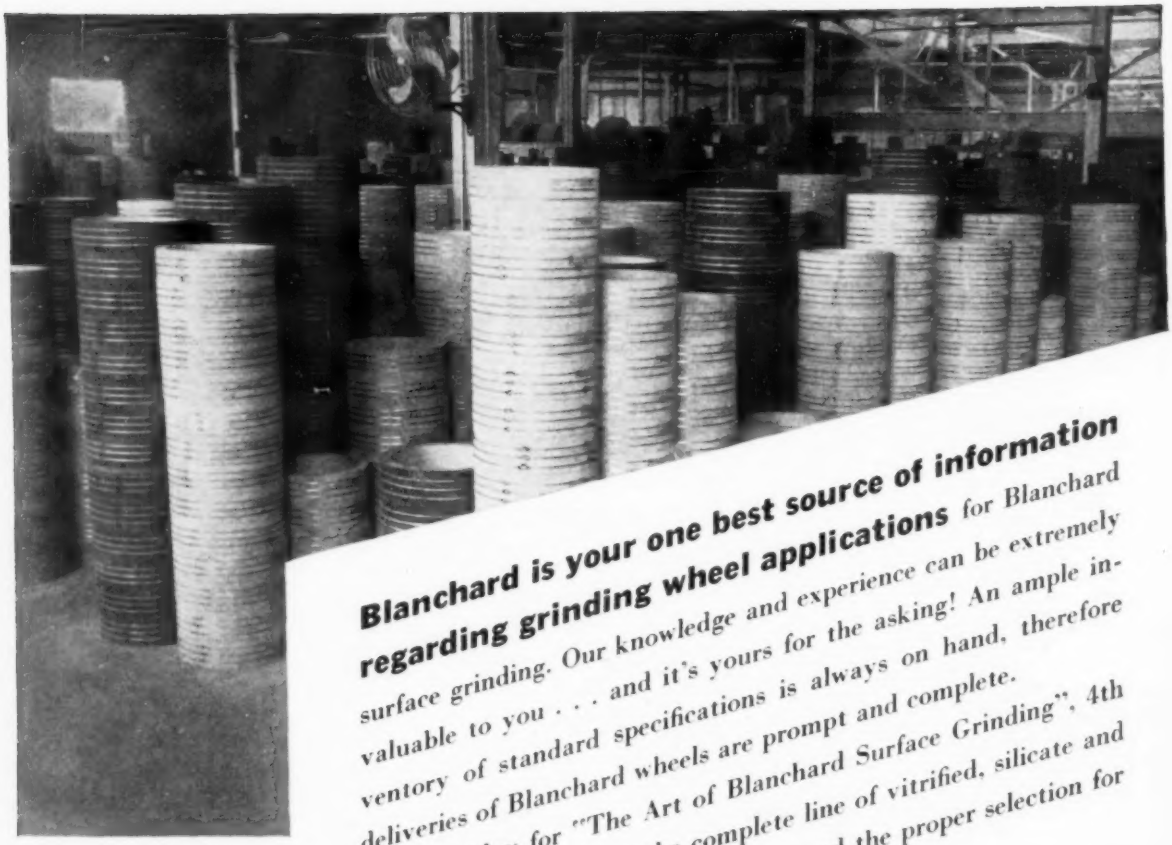
This new Cross pallet-type Transfer-matic completely machines aluminum die cast power frames for typewriters at a rated capacity of 150 per hour.

One hundred and five broaching, milling, drilling, reaming, spotfacing, chamfering and tapping operations are performed on each part. The delicate castings are precisely power clamped in pallet-type, two-position work holding fixtures, and transported through a loading station and eleven machining stations. Each part travels through the machine twice. On the first trip, the top, bottom and back side are exposed to the tools. On the second trip, the ends are exposed.

Tolerances for the rail seats are maintained in plane within ± 0.001, for the overall length within ± 0.003, for the shaft holes in line from end to end within ± 0.001, for the hole locations relative to milled surfaces within ± 0.003, and for the four broached spring seats in plane within ± 0.005.

A Cross Machine Control Unit with Tool-ometers programs tool changes to minimize down time. Standard Cross Tool Setting Fixtures are used to pre-set all tools, thus eliminating trial cuts and adjustments.

Other features are complete interchangeability of all standard and special parts for easy maintenance, construction to JIC Standards, hardened and ground ways and automatic lubrication.



Blanchard is your one best source of information regarding grinding wheel applications for Blanchard surface grinding. Our knowledge and experience can be extremely valuable to you . . . and it's yours for the asking! An ample inventory of standard specifications is always on hand, therefore deliveries of Blanchard wheels are prompt and complete.

Send today for "The Art of Blanchard Surface Grinding", 4th edition, which describes the complete line of vitrified, silicate and resinoid bonded wheels and segments and the proper selection for Blanchard vertical spindle surface grinders.

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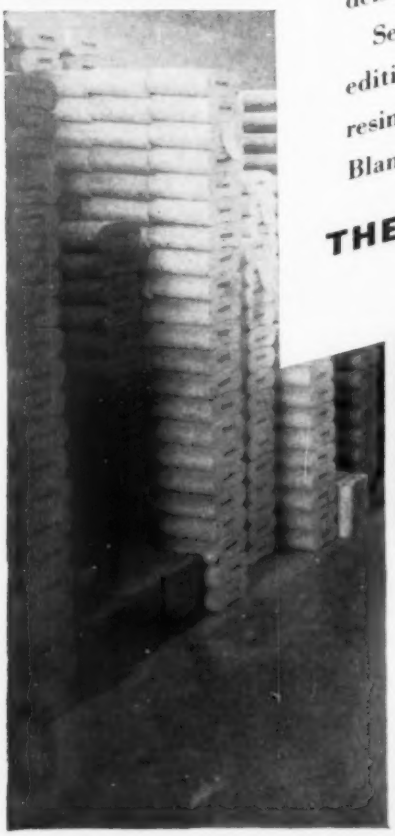
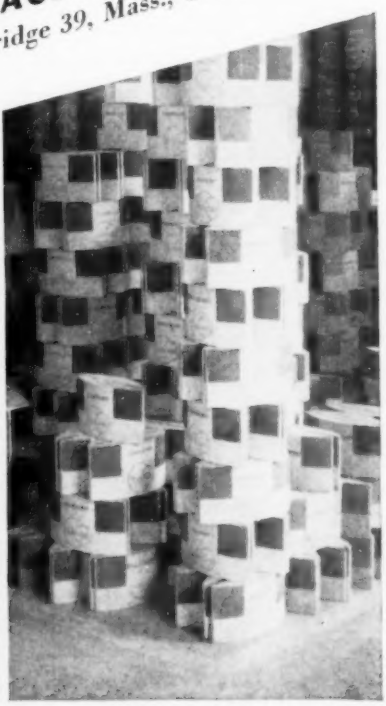




Twin magazine feeder DOUBLES PRODUCTION

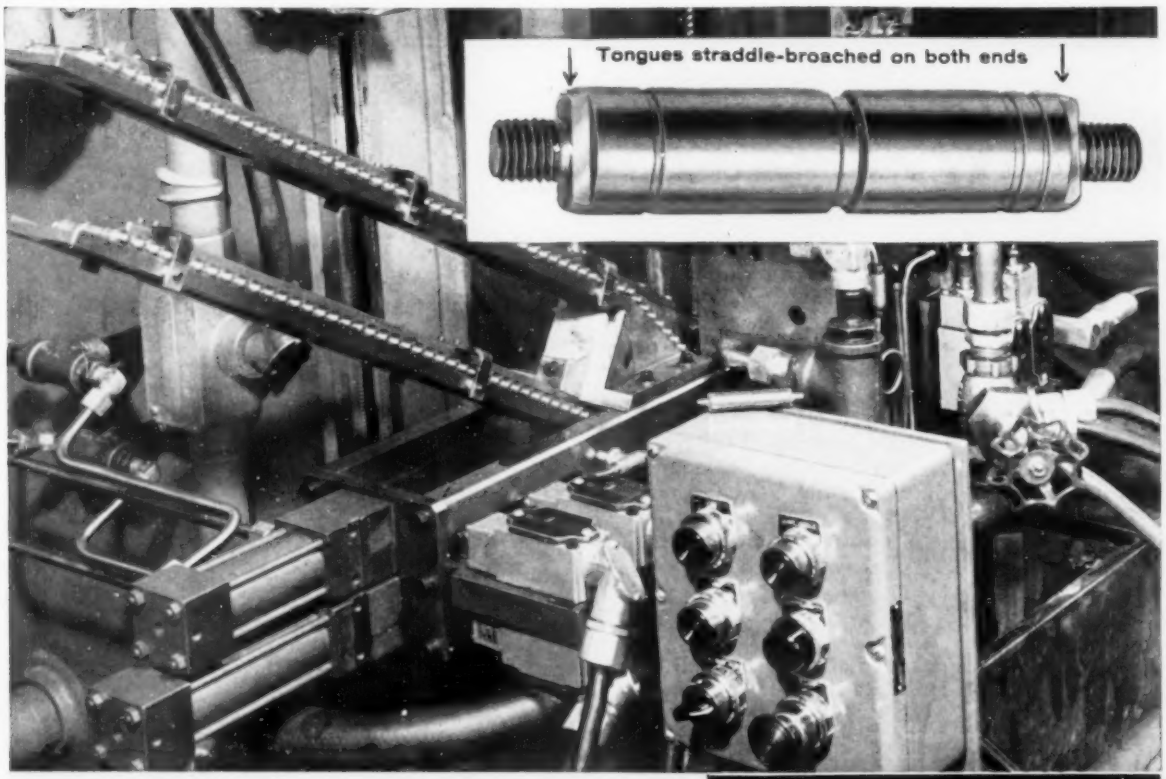
in straddle-broaching the tongues on both ends of this GEAR SHAFT

Equipment used . . . the LAPOINTE FABRICATED PRESS

BROACHING MACHINE

The Lapointe Vertical Broaching Press is extremely efficient anyway, but when it can be equipped with a twin magazine feeder you will obtain some amazing production figures. For instance: broaching these gear shafts at a rate of 10-per-minute . . . more than 600 per hour! It's accomplished by broaching two complete parts (one above the other) with each cycle of the fully-automatic machine.

If you are now milling parts that should be broached — or machining any repetitive forms to close tolerances — you may be agreeably surprised to learn what you can save, *in cost and quality*, by conversion to Lapointe-Broaching. Why not ask a qualified Lapointe Field Engineer to come to see you?



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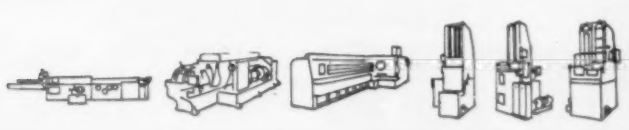

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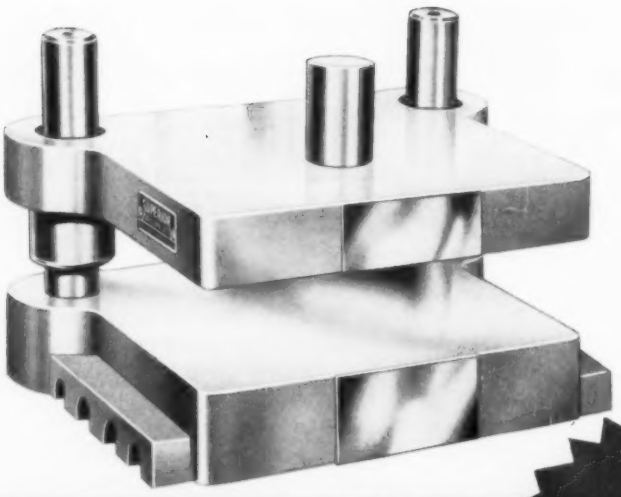
known to be the best in

BROACHING



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No fumbling or wasted time with large or small die sets when you use Superior. Assembly and disassembly of these precision sets is rapid. In addition they provide safety insurance . . . protection for the skilled hands of die makers and handlers . . . protection also against the ruining of costly dies in handling, or even damaging valuable press equipment.

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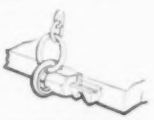
SAFETY FLANGE

protects fingers by providing roomy gripping space on either side of the die shoe.

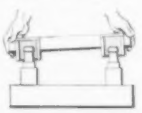


LOCK-JAW LIFTING DEVICE

removes the danger of handling large die sets.

E-Z LIFT SLING CHAIN

attach to the lock-jaw for immediate lifting.



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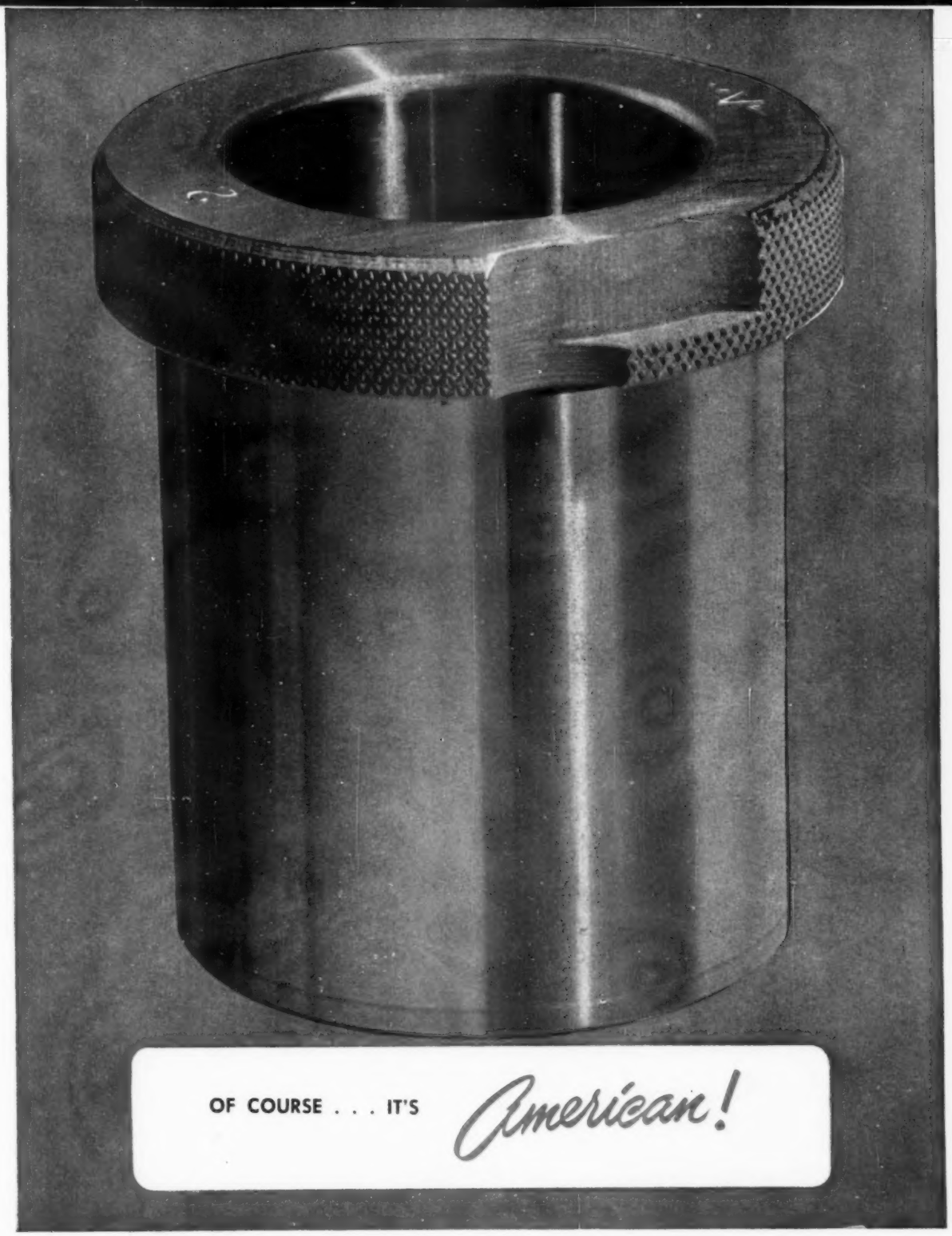

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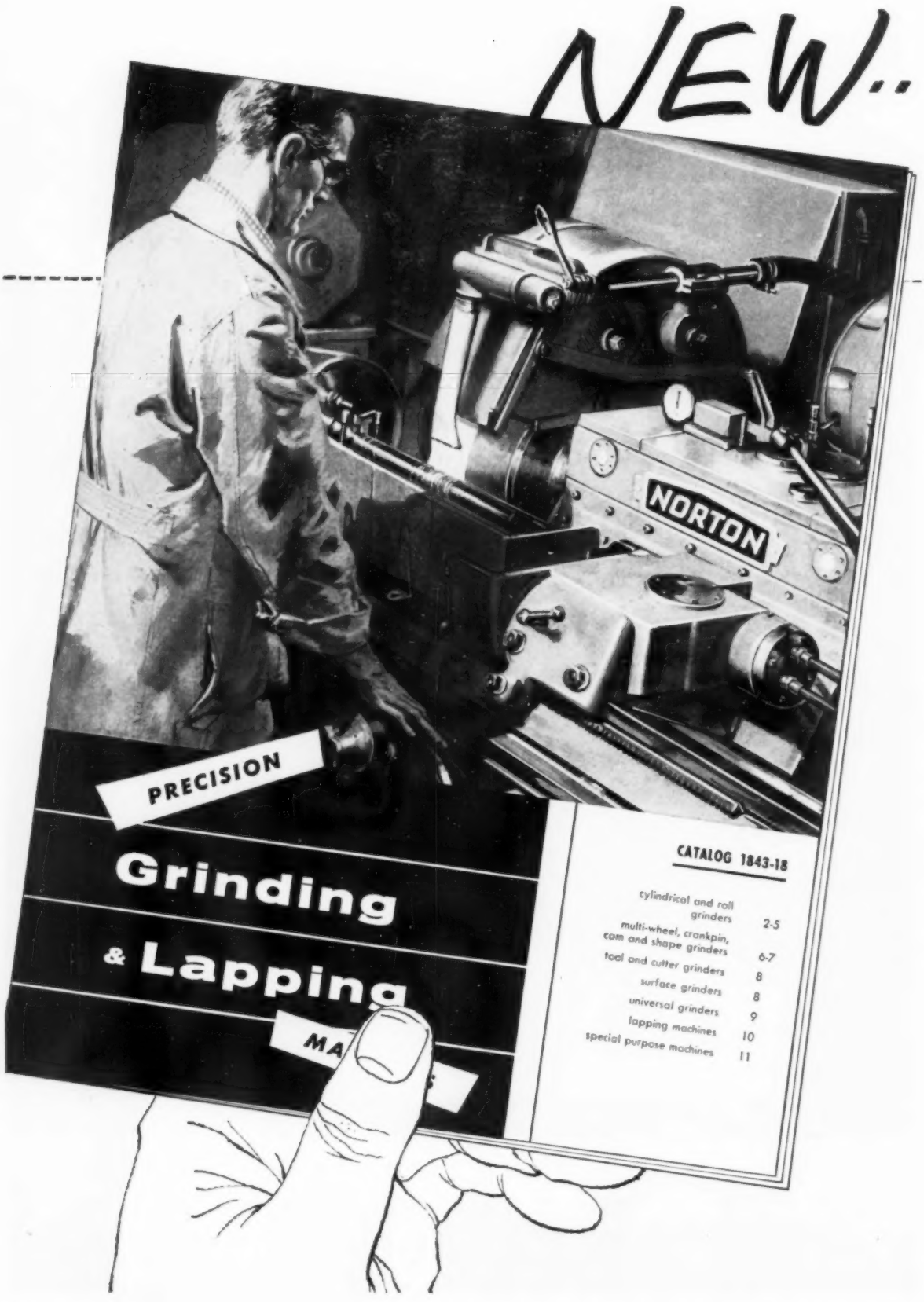
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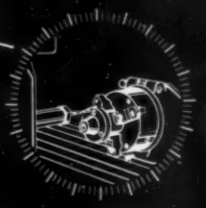
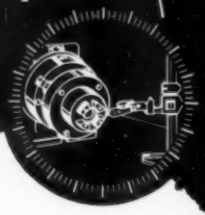


milling

jig drilling
with either micrometer or "Jo" block setting

inspection



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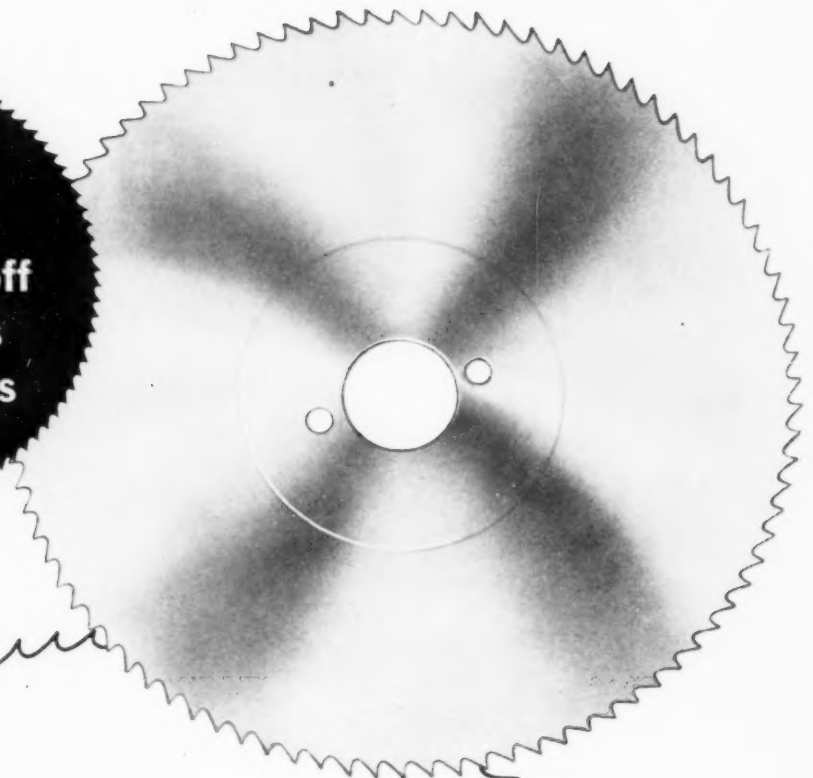
M & M blade speeds up cut-off of soft metals and their alloys



Higher speed to boost output, greater accuracy to step up quality—that's what you'll get when you cut off soft metals and their alloys with Motch & Merryweather's new, specially-engineered PolyMetal Blade.

This new blade is tougher, longer lasting. It's made of special analysis steel that combines desirable hardness, strength, shock resistance, toughness and wear resistance to produce just the right blade for metals like aluminum, magnesium, brass, bronze, copper and their alloys.

In M & M's PolyMetal Blade you get other outstanding features, too. Typical examples:

- **suitability for use on either hand or mechanically fed sawing machines**
- **uninterrupted performance—month in and month out**
- **easier sharpening to original cutting efficiency without special sharpening equipment**

Learn more about the PolyMetal Blade and the many advantages of making your local M & M dealer your single source for cutting tools. Call him today and whenever you have troublesome cutting problems.

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S *Service*
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drill · ream · chamfer spot-face · center · deburr

do all these operations

and more

with the SERIES 26

DUMORE®

AUTOMATIC DRILL UNIT

Only

$550* *Complete*

Catalog No. 26-062
½ hp., 208/220 V., 50/60 cy. 3 phase, totally enclosed motor 1440/1725 rpm

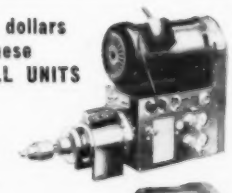
***F.O.B. Racine**

This unit is a quality engineered, compact driving head for a wide variety of machining. It is fully automatic with built-in basic electrical and pneumatic controls. It is ideal for long production runs or multiple set-ups where frequent changeovers are not necessary.

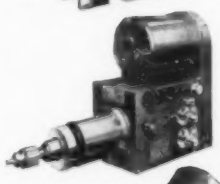
It is a powerful, versatile, all-purpose unit that lets you use it where you need it—on drill presses, fixtured set-ups, bench mounted; or added to special-purpose building-block production machines, transfer stations and other automatic machining systems. Keeps right on working on set-up after set-up!

This special Dumore nose mounting bracket is your key to all-purpose machining—*anywhere*. It permits fast, easy mounting in any position, angle or direction in single set-ups, or multiple machining operations in sequence. Changeovers, when necessary, are made quickly, speedily. Return to original set-up is equally fast!

You can save hundreds of dollars in first cost alone with these DUMORE AUTOMATIC DRILL UNITS



Series 28
"Drill-N-Tap" Unit — 2 tools in 1 at the cost of only one. Drills or taps at the flip of a switch. Tap fits into chuck, no extra head required. Reversing motor removes tap, eliminates costly clutches. 265 to 4900 rpm. For long or short runs.



Series 24
Fully automatic with all controls built-in. Preselected speeds, feeds, depths. Ideal for varying runs and frequent changeovers.

Series 20
Automatic Drill Heads for high production drilling of small parts. Stops drill breakage. Built-in controls. No. 80 to 5/32" capacity.

DUMORE® **ALL-PURPOSE PRECISION METALWORKING TOOLS**

THE DUMORE COMPANY • 1310 17th St., Racine, Wis.

VERSA-MIL • DRILL-N-TAP UNITS • DRILLING UNITS • DRILL HEADS
MICRO DRILLS • DRILL GRINDERS • TOOL POST and HAND GRINDERS
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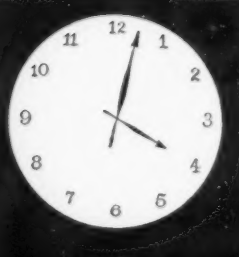
is a tough air-hardening tool and die steel that saves money and time by virtually eliminating the fitting and adjusting of dies after hardening. Its ability to resist distortion and size change is the most dependable in the industry. VEGA is the only steel that combines the machining properties of an oil-hardening grade with the safety in hardening normally found in air-hardening steels. Prove it to yourself. Call your local Carpenter SERVICE-CENTER today for immediate delivery.



the *Carpenter* Steel Company, Reading, Pa.

new Fairchild F-27 have the "mettle in their

First American propjet transport designed for short and medium-range operators . . . both airline and corporate . . . the new F-27 is the proven successor to the famed DC-3.

From design to production, the best brains and equipment in the aircraft industry have been employed for 5 years in the development of this new plane. So it follows that Morse Cutting Tools . . . particularly Morse Aircraft Drills and Router Bits . . . were used in construction. Because it *takes* quality to *make* quality . . . and the mettle of Morse Tools is a *known quantity*.

Likewise, on *your* own cutting tool needs, it pays to mark your orders "Morse". Let your Morse-Franchised Distributor show you exactly why. Call him today.

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A division of VAN NORMAN INDUSTRIES, INC.
Warehouses in New York, Chicago, Detroit, Dallas, San Francisco

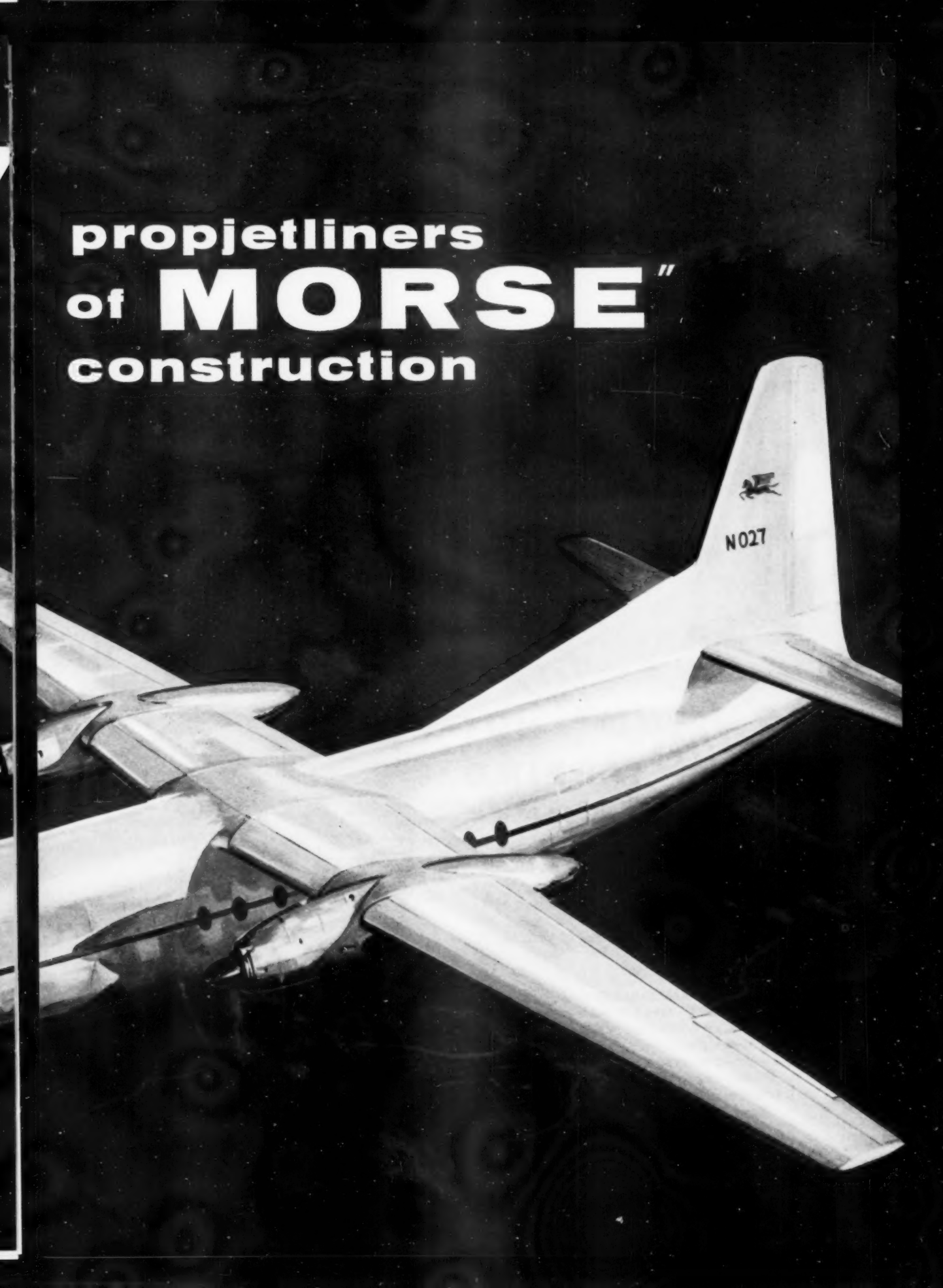
The F-27 is made in the USA by Fairchild Engine & Airplane Corp., Hagerstown, Md. Cruising speed, 280 mph. Range up to 2500 miles. Takeoff distance, 3680 ft.

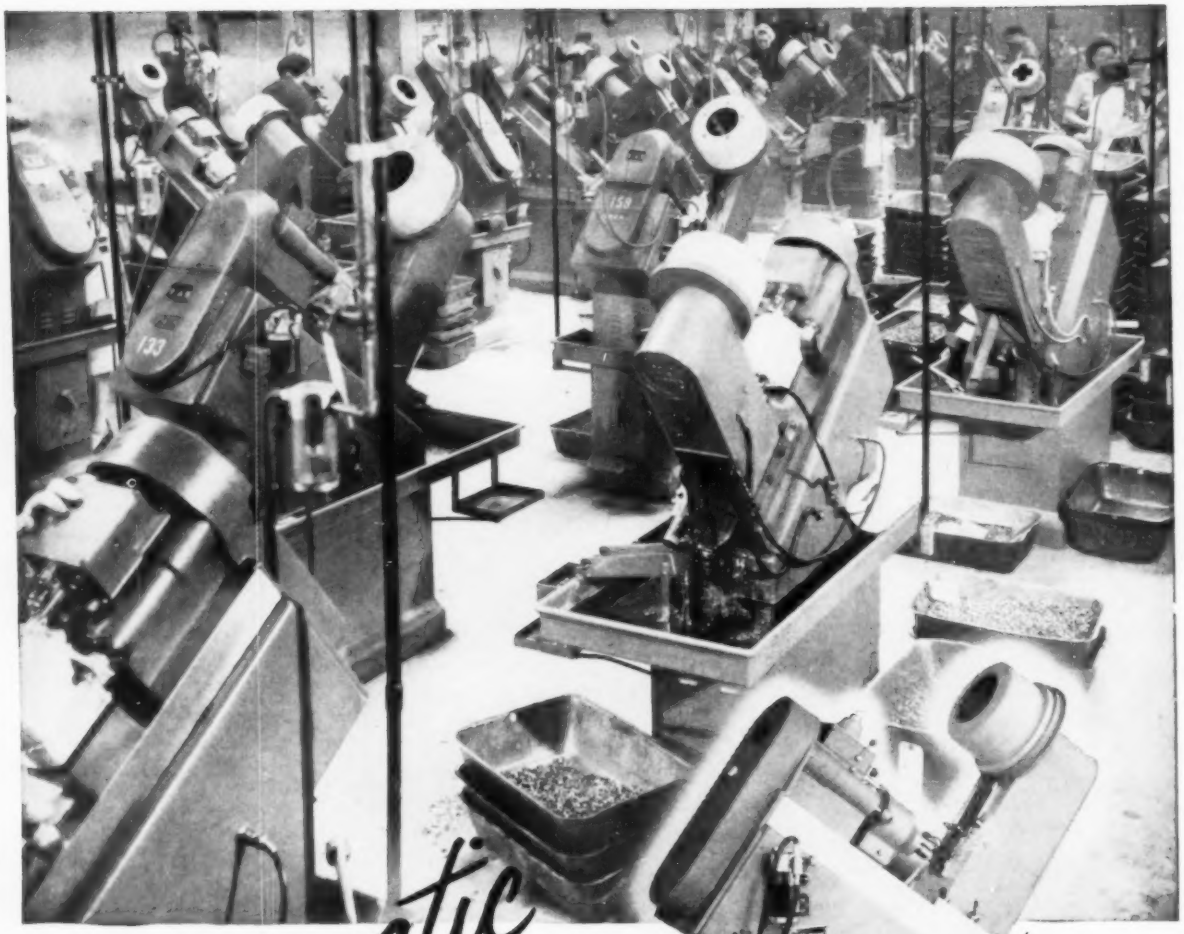
. . . in Cutting Tools

MORSE

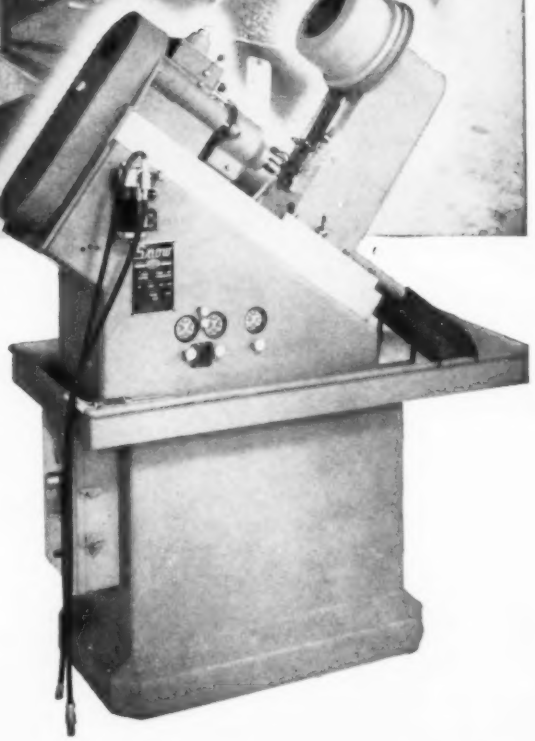
means "THE MOST"

propjetliners of MORSE construction





Automatic NUT TAPPING MACHINES



This installation *at Shakeproof, Division of Illinois Tool Works, Elgin, Illinois,* is an illustration of productivity—*with precision.*

Simplicity of set-up and lower operational costs can make your Nut Tapping Department one of the most efficient and profitable in your plant. Submit samples and prints for a comparison with your present method.

VERTICAL DRILLING MACHINES
VERTICAL TAPPING MACHINES
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435 EASTERN AVENUE, BELLWOOD, ILL.

(Suburb of Chicago)

why you should put SUPERFINISH in your blueprints

Longer life, better performance—yes, and *lower costs, too*—should be engineered into the product at the start. For example: when you specify Gisholt SUPERFINISH, you accomplish two things: First, you assure a bearing surface free of the imperfections that cause wear—a surface that will last indefinitely. Second, you cut the cost of grinding—or even eliminate it. Surprisingly enough, you can in most cases achieve this superlative finish at lower over-all cost than is possible with other methods of finishing.

Contains revised material from original textbook "Wear and Surface Finish" plus machine data, job applications and machine floor plans.

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ASK YOUR GISHOLT REPRESENTATIVE ABOUT GISHOLT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

Gisholt Machine Company
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Gentlemen:
Please send my free copy of new Gisholt Superfinisher Catalog.

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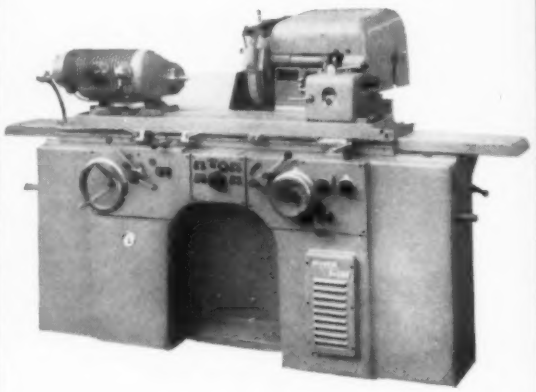
olivetti

high-precision grinding machines with hydraulic automatic infeed for traverse grinding and plunge grinding as standard equipment on all models.



3 types:

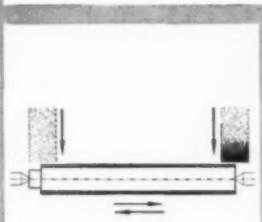
UNIVERSAL. *Swivelling wheelhead, internal grinding attachment, infinitely variable speed headstock.*

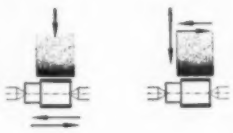
PRODUCTION. *Larger grinding wheel, more horsepower, non-swivelling wheelhead, 8-speed headstock.*

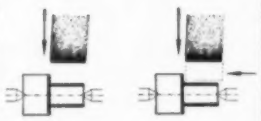
PLUNGE. *Similar to production type but with axially oscillating wheelhead and hand table control only.*

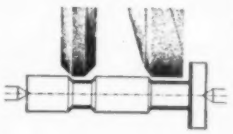
4 sizes:

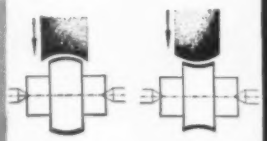
10", 12", 14", and 18" swings (with choice of lengths between centers).





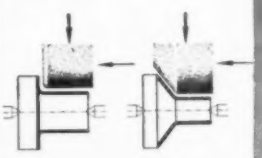






Olivetti has been making quality machine tools since 1926. For sales, service or information, call or write Olivetti Corporation of America, Machine Tool Division, 42-33 Northern Boulevard, Long Island City, New York.

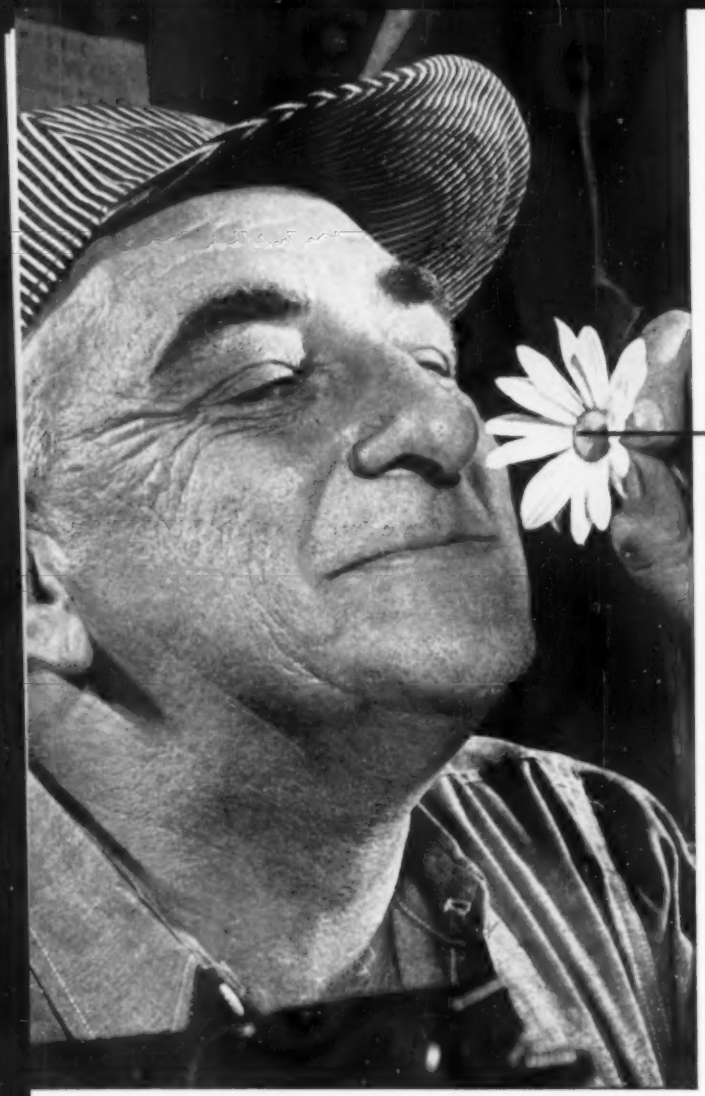
CATALOG ON REQUEST *Handsome, illustrated, 22 pages. Please write for it.*



DISCOVERED!

...new way to keep cutting fluids as fresh as a daisy!

SEE NEXT TWO PAGES



DISCOVERED...A NEW WAY TO KEEP COOLANTS FRESH AS A DAISY!

Shop tests show ELCIDE 75 keeps cutting fluids fresh longer than ever before

Now . . . there's a new and better way to control the harmful bacteria that cause oil-water emulsion breakdown, acidic corrosion, and rancid odor. It's Elcide 75 . . . a product directly related to one of the most powerful bacteria killers used in medical science today . . . a material that has proved itself in the exacting field of surgical practice and has now been adapted to solve the problem of bacterial growth in soluble oil emulsions.

A large Midwestern manufacturing plant tested Elcide 75 under actual job conditions.

They found that one ounce of Elcide 75 added to each 4 gallons of oil-water emulsion . . .

extended useful life of the emulsion 5½ times . . .

greatly reduced cutting oil requirements . . .

delayed odor and emulsion break for 22 weeks, while untreated machines had to be dumped at the end of four weeks . . .

proportionately reduced down time for recharging . . .

was safe and nontoxic . . .

eliminated bacterial slime and reduced acidic corrosion . . .

drastically reduced their disposal problems.

WHAT ELCIDE 75 CAN DO FOR YOU

This combination of inhibitors can extend the life of your oil-water emulsions 2 to 4 times, or more, and can dramatically cut your oil-concentrate purchases. At the same time, production will increase because you have less down time for recharging.

ELI LILLY AND COMPANY · AGRICULTURAL AND INDUSTRIAL PRODUCTS DIVISION
INDIANAPOLIS 6, INDIANA
TELEPHONE: MELROSE 6-2211

This is one of the causes of emulsion trouble. These are *Pseudomonads*, one of the many harmful types of bacteria found in oil-water emulsions. These, and other bacteria, enter emulsions through the air, water, and plant debris. They set the stage for a chain reaction which causes odor, corrosion, and costly emulsion breakdown.

Prior to Elcide 75, no single inhibitor was able to control the full range of bacterial growth. Certain of these bacteria quickly develop resistance to single inhibitors and continue to flourish. Now, Elcide 75 controls a wider range of bacteria because it is an effective combination of bactericidal agents. This has been proved in shop tests.

In certain areas where waste-oil disposal is a problem, the use of Elcide 75 proportionately reduces the size of the problem.

Elcide 75 also contributes to better products and longer machine-tool life. Bacterial contamination causes acidic decomposition of the emulsion and sets up conditions for corrosion. By controlling the bacteria, you eliminate this source of trouble.

Employees like Elcide 75 because, when added to the emulsion, it is completely safe. In another recent test involving over 1000 machines, it was shown that Elcide 75 was safe, nontoxic, and harmless to sensitive skin. It also reduces the chance for bacterial infection caused by contaminated emulsion.

YOU KNOW WHAT YOU GET WHEN YOU BUY ELCIDE 75

With Elcide 75, you know you have the proper amount for effective treatment because you add it to your emulsions right in your plant. The standard recommendation is one ounce of Elcide 75 per 4 gallons of oil-water emulsion.

PROVE IT TO YOURSELF... TRY ELCIDE 75 IN YOUR PLANT

The best way to determine the value of Elcide 75 is to try it under your normal plant conditions, using your regular oil-water emulsion. After you've had an opportunity to compare results, we believe you'll agree that Elcide 75 is a valuable discovery that will greatly increase your plant efficiency.

PRODUCT SPECIFICATIONS ELCIDE 75

(Lilly's brand of bactericide for cutting fluids)

Active Ingredients—Thimerosal (Sodium Ethylmercuri Thiosalicylate) and Sodium o-phenylphenate.

Package	Price per Gal.
1-gallon polyethylene . . .	$8.50
5-gallon polyethylene . . .	$8.00
55-gallon stainless steel . . .	$6.50

Terms: 1%, 10th prox.; net, 30th prox. F.O.B. Indianapolis. Transportation paid via carrier of our selection.

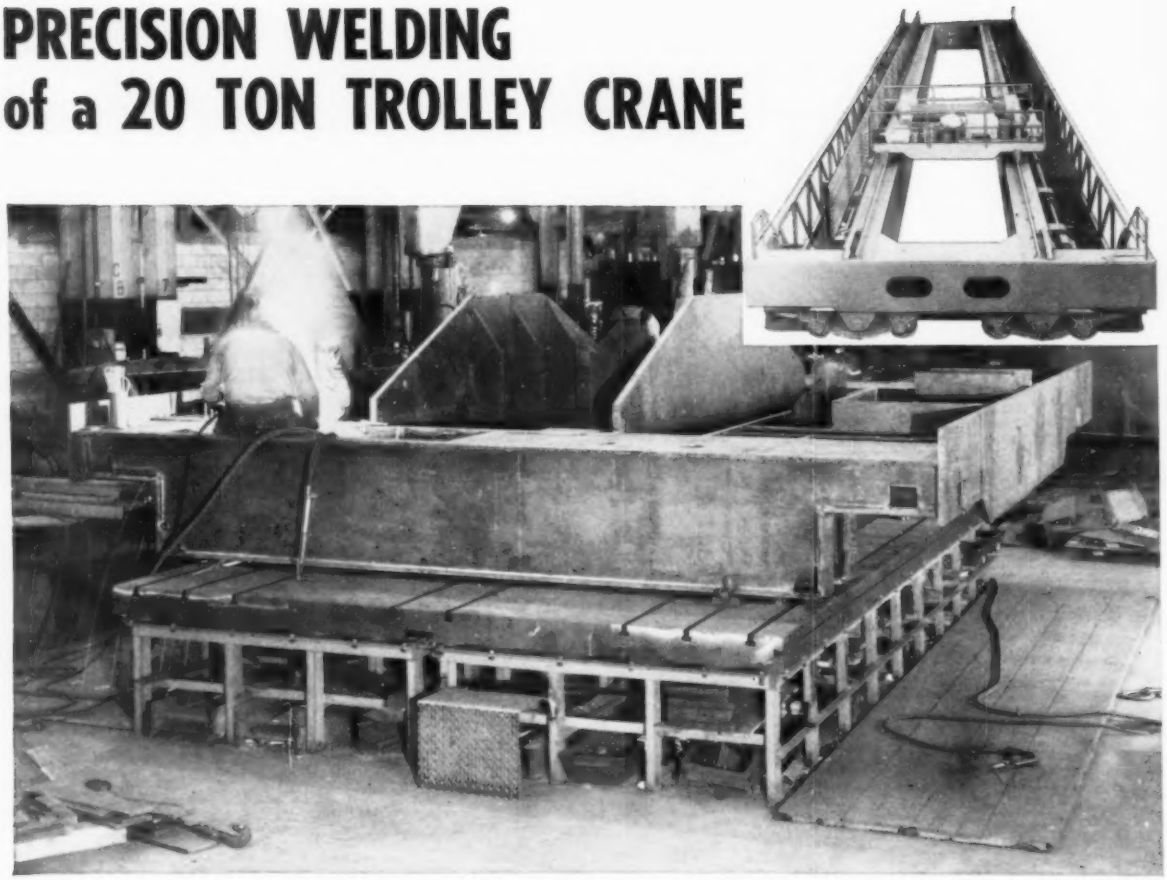
For further information or to place your order, phone or write.

ELCIDE 75™

PATENT PENDING

Lilly

PRECISION WELDING of a 20 TON TROLLEY CRANE



Another example of PRODUCTION SAVINGS *with* CHALLENGE®

PRECISION SURFACE EQUIPMENT

To reduce machining costs on the production of the 20-ton trolley crane assemblies for their huge cranes, Shaw-Box Crane & Hoist Division of Manning, Maxwell & Moore, Inc., decided to go to precision welding.

Needed was a large, accurate surface capable of supporting these large assemblies and providing an accurate reference base for the precision welding operation.

To provide the answer, Challenge supplied its standard 12 x 18 precision sectional layout plate with T-slots on the top and sides to permit the use of holding devices and with scribe lines at right angles as an aid to accurate positioning.

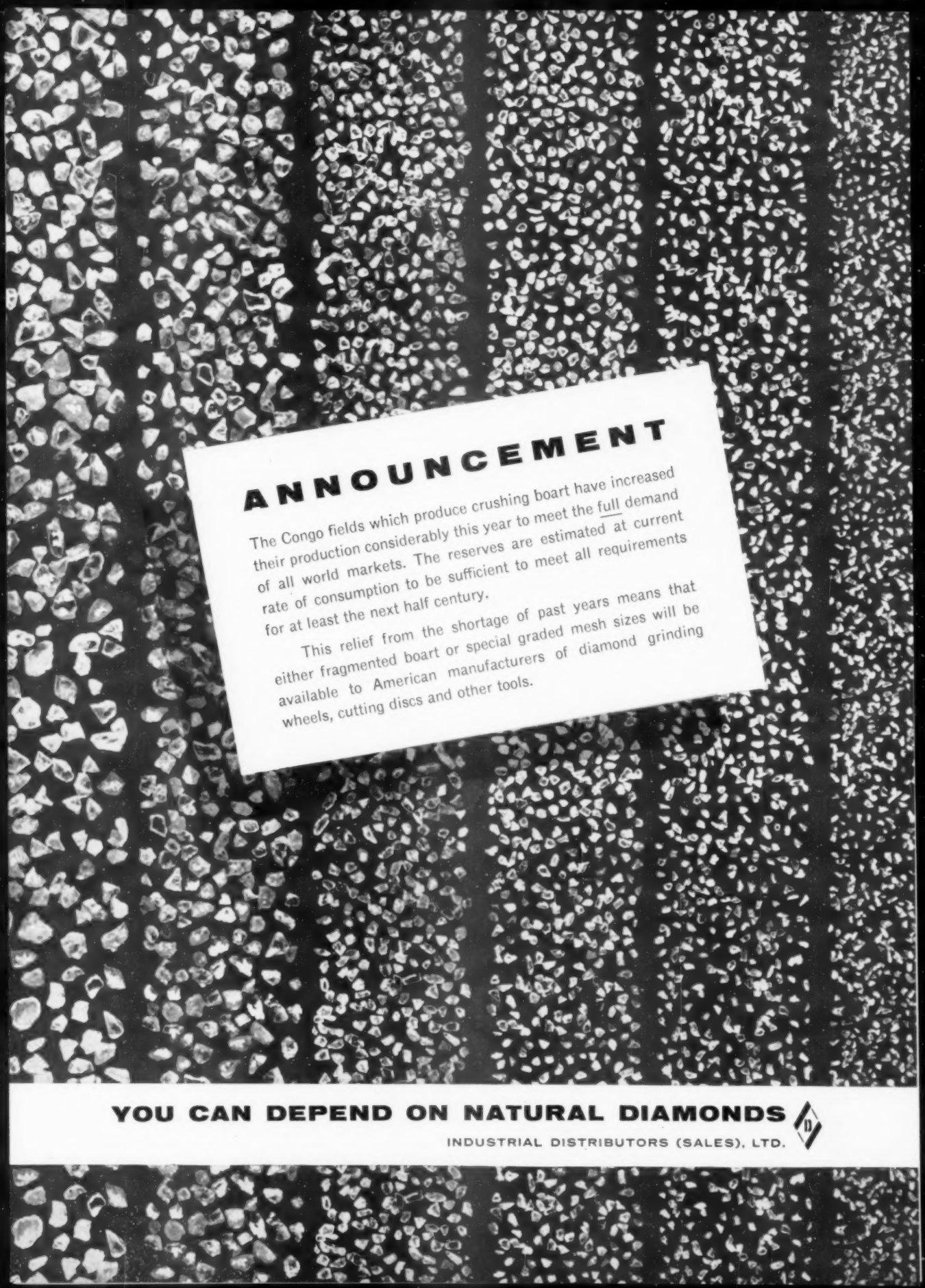
The results were so satisfactory, Manning, Maxwell & Moore purchased a second plate to expand these precision welding facilities.

When you have a problem requiring precision surface equipment of any type — semi-steel, granite, magnesium or aluminum — be sure to check Challenge, first! Ask for your copy of the catalog of Challenge **Standard** Precision Surface Equipment or write regarding your **special** needs.

Challenge

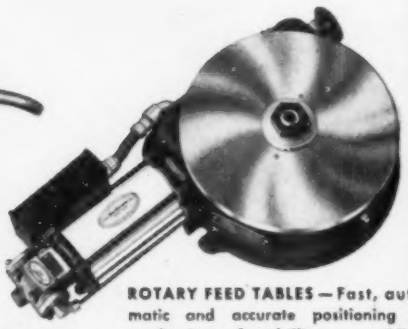
SE-118

THE CHALLENGE MACHINERY COMPANY • GRAND HAVEN, MICHIGAN


ANNOUNCEMENT
The Congo fields which produce crushing boart have increased their production considerably this year to meet the full demand of all world markets. The reserves are estimated at current rate of consumption to be sufficient to meet all requirements for at least the next half century.
This relief from the shortage of past years means that either fragmented boart or special graded mesh sizes will be available to American manufacturers of diamond grinding wheels, cutting discs and other tools.
YOU CAN DEPEND ON NATURAL DIAMONDS
INDUSTRIAL DISTRIBUTORS (SALES), LTD.

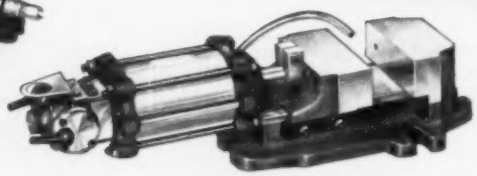
YOU CAN CUT COSTS 30% OR MORE RIGHT

DRILL PRESS FEEDS — Quickly attached to any standard drill press, these units replace manual control of feed rates with automatic air-hydraulic precision control.



ROTARY FEED TABLES — Fast, auto matic and accurate positioning o work pieces for drilling, assembling welding, etc.

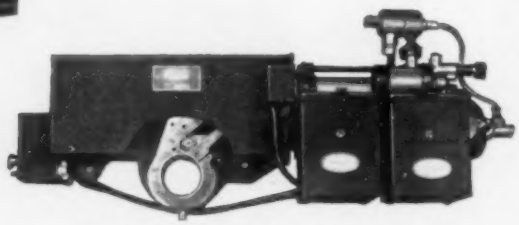
SHUTTLE WORK FEEDER — A 2-station linear 6" stroke work feeder... load or unload while drilling, tapping, etc. is being done at other station.



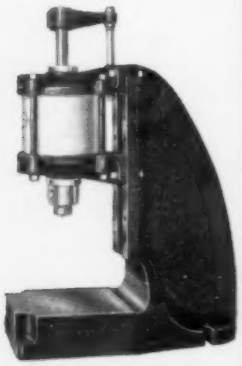
"CONTROLLED-AIR-POWER" VISE — Quick acting air vise for fast tool and fixture work; clamping pressure approximately five times air line pressure.

THE BELLOWS AIR MOTOR — The ai cylinder with the integral valve and speed controls, for low voltage a 115-volt control circuits.

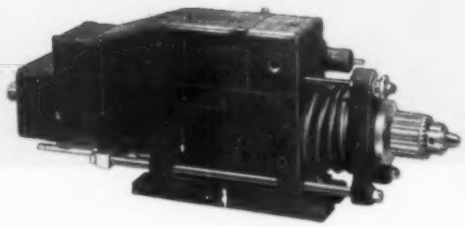
AIR-HYDRAULIC VISE — A milling machine type vise developing a clamping pressure up to 15,000 lbs. on 100 lbs. operating air line pressure.



HEAVY DUTY POWER FEED—A complete packaged power unit designed primarily to replace manual infeeding in centerless grinding operations.



AIR PRESSES—Provide either a controlled pressure squeeze for pressing operations or a sharp impact for stamping, coining or staking.



BELLOWS-LOCKE DRILLING and TAPPING UNIT— An air-powered hydraulically controlled drill unit for quick incorporation into high production drilling or tapping operations.

These Bellows work units are air-powered but electrically controlled. Directional valving and speed controls are built-in. Only a single air connection is required which can be made with flexible air hose. All units can be interlocked and synchronized with one another for programmed operation. Economical to buy, simple to install, they give immediate cost cutting results to any plant in any industry.

NOW WITH THE HELP OF THESE

Bellows "Controlled-Air-Power"

PRODUCTION UNITS

Bellows production units are pneumatic powered devices that are easily installed on standard machines to make them operate automatically. They save costs by cutting the time of the work cycle; by grouping related operations on one machine often saving the complete labor cost of the second operation; by making it possible for one operator to run two or more machines; by maintaining quality standards with fewer rejected parts; by using lower hourly-rated employees to turn out top quality work.

You can install Bellows work units right in your own plant, with your own tool room personnel, with a minimum of machine downtime (often no more than a couple of hours.) In many cases, Bellows Field Engineers can provide you with wiring diagrams and schematic drawings right from their case history files, and with information that will enable you to estimate *quickly* the cost savings you can make.

Best of all, the initial cost to buy and install Bellows "controlled-air-power" work units is small — often less than the wage cost of a machine operator for a couple of weeks.

The Bellows Co.

DIVISION INTERNATIONAL BASIC ECONOMY CORPORATION

AKRON 9, OHIO

1110-B

If you do any of these typical operations, you can start an effective cost cutting program by mailing the coupon at the right.

DRILLING • REAMING • TAPPING • TURNING
MARKING • STAMPING • PUNCHING • GRINDING
ROUTING • SAWING • THREADING • SPINNING
RIVETING • MILLING

The Bellows Co., Akron 9, Ohio
Dept. TE-1058

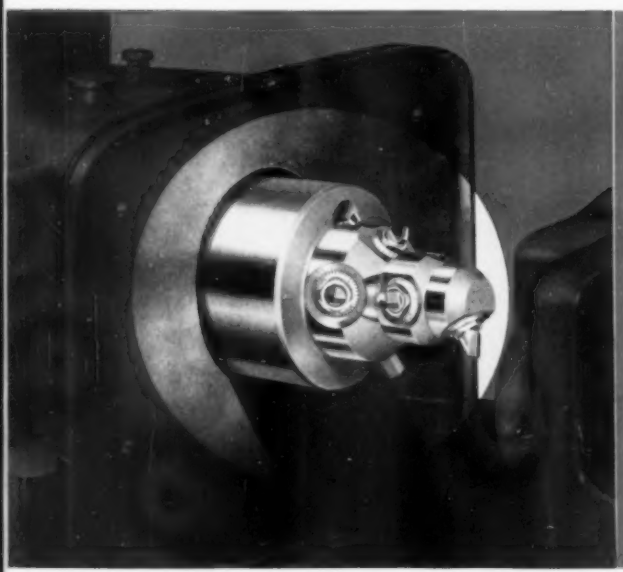
Please send me the story how Bellows "Controlled-Air-Power" can help me cut costs.

Name _____

Company _____

Address _____

now, pre-set tools to accurate part dimensions outside the machine with this new Microbore® System

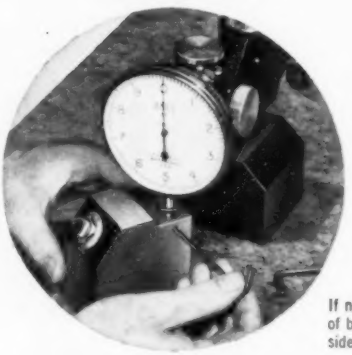


SIMPLE 4-STEP PROCEDURE

1. To set up pilot tool, insert Microbore "Pre-Set" unit in boring bar. Adjust to part dimension by trial cut and final setting using Micrometer Vernier adjustment.

2. Remove adjusted pilot tool from the boring bar and install in the standard Microbore setting block.

3. Position indicator stylus on high point of pilot tool in setting block and adjust indicator to zero.



4. Adjust gage pin to same zero setting. Any number of additional tools may now be pre-set and interchanged with pilot for precision boring the same diameter.

If necessary to pre-set for depth of bore, tumble block to adjacent side and repeat procedure.

Eliminate trial cuts... change tools in seconds... simplify tool maintenance

Using a standard setting block and indicator, Microbore tools can now be pre-set to accurate part dimensions outside the machine and quickly locked in the boring bar or tool holder without further adjustment.

"Pre-Set" eliminates scrap parts due to trial and error set-up and greatly reduces down time for worn tool point adjustment. "Pre-Set" encourages the operator to keep sharp tools in the machine assuring greater accuracies and produces the maximum number of pieces per tool grind by minimizing breakage due to dull tools.

"Pre-Set" also makes it possible to replace worn tools without changing the entire boring bar or tool holder—eliminates the need for stand-by bars —simplifies tool grinding and maintenance.

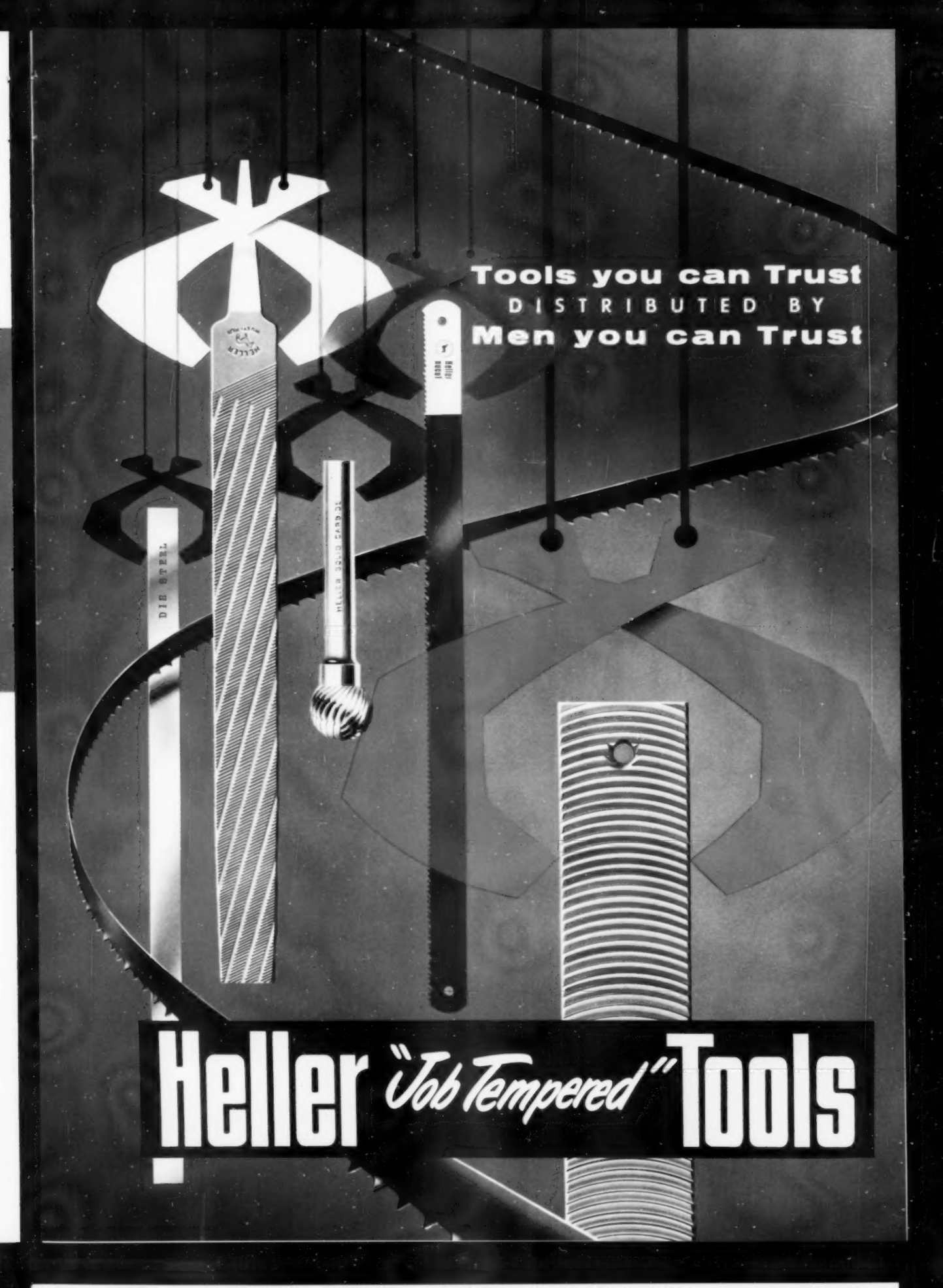
Microbore System of "Pre-Set" tooling may be applied to boring, turning, facing and chamfering operations and is especially suited to production and automated operations where machines must maintain peak production on long runs. Write for complete information.

The DeVlieg Microbore System of Adjustable Precision Tooling includes Standard Microbore Boring Bars and Boring Bar Sets, Special Cluster Tooling, Flash-Change Tooling and Tool Holders, Flash-Change Replacement Bridgeport Spindles, Turret Lathe Turning Heads and Adjustable Boring Heads.

DeVlieg Microbore® System

DE VLIEG MICROBORE • DIVISION OF DE VLIEG MACHINE COMPANY

Fair Street, Royal Oak, Michigan


Tools you can Trust
DISTRIBUTED BY
Men you can Trust
Heller "Job Tempered" Tools

TRUSTED WHEN UNIFORMITY COUNTS

Heller

"Job Tempered"

METAL CUTTING Band Saws

CONSISTENTLY DEPENDABLE PERFORMANCE is assured by the *uniform teeth, uniform set* and *uniform temper* of every Heller Band Saw . . . as certified by American Standards Testing Bureau. This three-point uniformity stems from the unique combination of precision manufacture and "Job Tempering" that distinguishes the Heller brand from all others.

EXTRA VALUE is built into every Heller Band Saw by "Job Tempering" . . . a technique based on Heller's long experience in matching steel specifications and unusual heat-treating methods to metal-cutting demands. Special machining methods and precision tooth setting result in superior performance and longer life.

YOUR TRUSTWORTHY HELLER DISTRIBUTOR is fully stocked with Heller "Job Tempered" Band Saws that fit your needs . . . in regular and wavy set . . . in standard, skip and hook tooth shapes . . . in lengths and widths for all machines and all contours. Call on this dependable source of cost-cutting tools for the prompt deliveries that prevent costly down time.

HELLER TOOL CO.

America's Oldest File Manufacturer
NEWCOMERSTOWN, OHIO
Subsidiary of Simonds Saw and Steel Co.

Branches and Warehouses: Newark • Detroit • Chicago • Shreveport • Los Angeles • Portland, Ore.

(Above) Red-hot steel slabs, weighing over 2 tons each, are at arm's length from hydraulic lines filled with Irus Fluid 902—YET NO FIRE HAZARD.

(Right) The distinctive yellow color of Irus Fluid makes it easy to spot and trace hydraulic line leaks.

"After numerous tests, we selected Shell Irus Fluid 902 because of its excellent fire resistance and low cost,"

says Norman Bracht, Lubrication Engineer, Alan Wood Steel Company, Conshohocken, Pa.

A fire in the strip mill, causing serious equipment damage and plant down time, convinced the Alan Wood Steel Company that a switchover to a fire-resistant hydraulic fluid was imperative. After extensive testing with various commercial types, Shell Irus Fluid 902 was selected. Now . . . twelve months later . . . Alan Wood is convinced that serious hydraulic fires in strip mill tilt table are a thing of the past.

Irus* Fluid 902 is a specially compounded water-in-oil emulsion which has exceptional fire resistance. Plant tests show, time after time, that Irus Fluid 902 *actually snuffs out fire!*

Many plant operators, like Alan Wood Steel, have discovered that Irus Fluid is economical . . . costing up to one-third less than other fire-resistant fluids, yet its performance is comparable in every practical respect.

If your present hydraulic equipment is vulnerable to accidental fire hazard, we suggest that you obtain complete technical information on Shell Irus Fluid 902. Write: Shell Oil Company, 50 West 50th Street, New York 20, N.Y. or 100 Bush Street, San Francisco 6, California.

*Registered Trademark

SHELL IRUS FLUID 902

a low-cost, fire-resistant hydraulic fluid

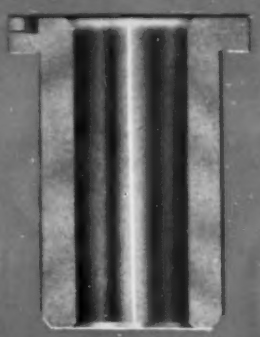
SHELL

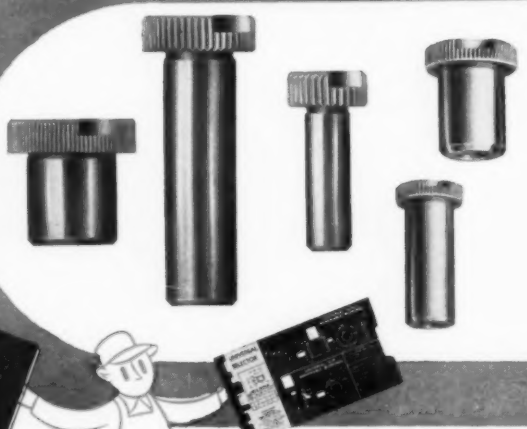
you get close tolerance drilling with

UNIVERSAL DRILL BUSHINGS

Accurately machined bushings are essential when drilling to close tolerance. UNIVERSAL DRILL BUSHINGS, of finest quality steel, are carefully tested for 100% concentricity and hardness, assuring pin-point accuracy and uniform quality. To prevent tool hang-up and breakage, each bushing has a blended radius on the top inside diameter.

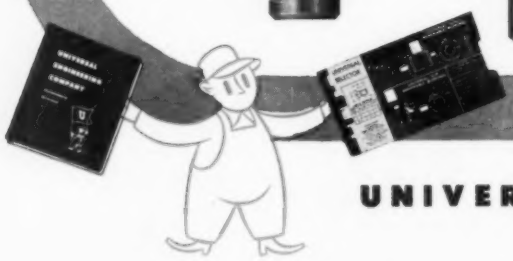
All bores are superfinished. This superfinishing of bushings is important, especially in close tolerance work, because it reduces both tool and bushing wear to a minimum. Knurled head gives a quick, sure grip.





We stock drill bushings in all standard sizes and lengths at each of the following offices—Universal Engineering Sales Co., 1060 Broad St., Newark 2, New Jersey; 5035 Sixth Ave., Kenosha, Wis., and at our home office in Frankenmuth. Contact the nearest office for immediate delivery.

The Universal Drill Bushing Slide Chart gives accurate engineering data for the selection of all types and sizes of drill jig bushings up to 1¾" drill size. You may have one—free—by requesting on your company letterhead. At the same time, get your copy of our new catalog that describes all of UNIVERSAL'S products including chucks, tool holders, boring bars, bushings and index plungers.

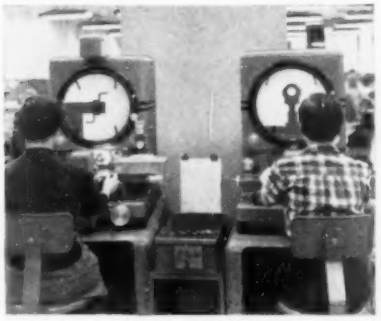


UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 3, MICHIGAN

207

See how optical gaging solves 4 basic inspection problems faster... at less cost



(1) RECEIVING: With optical gaging you get *immediate* checks on tolerance for incoming precision parts. One glance tells whether parts are to your specification. For example:

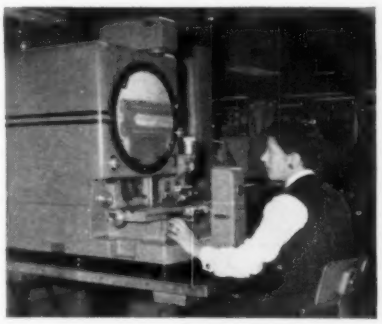
Inspectors at the *Allen-Bradley Company*, makers of electrical equipment, use Kodak Contour Projectors for fast, accurate inspection of incoming precision parts. They check *more than 400 different items*, most with multiple dimensions, and sample size of 35 or more pieces. Tolerances are held to .001". Since optical gaging permits checking several dimensions at once, Allen-Bradley has drastically cut inspection time. Parts are quickly cleared for production; quality control is better.

(2) ASSEMBLY: Mass producing your product may require fast yet accurate inspection of precision component assemblies. Here's how one manufacturer solved the problem:

Magnetron Beam Switching Tube, produced by *Electronic Tube Division, Burroughs Corporation*, has 21 elements which fit into mica holding-wafers at top and bottom. The elements must be lined up to within .002" of specifications. The problem was to do this complex inspection job *fast enough to keep up with assembly speed* in mass production. With a Kodak Contour Projector the inspector can easily match top assembly speeds while maintaining the required specifications.

(3) FINAL INSPECTION: You can inspect a great variety of finished parts quickly with the Kodak Contour Projector—and cut costs, too.

In one instance, a great variety of component parts for various manufacturers posed a serious inspection problem for *Auburn Plastics, Inc.*, a custom molder. The firm formerly used mechanical gages in large numbers to make necessary quality control checks. A Kodak Contour Projector eliminated the expense of buying mechanical gages (savings amounted to $5,000 in one instance). Now operators can inspect at a glance finished components—gage angles, radii, holes, and other dimensions—with an accuracy that meets close tolerances.



(4) PRODUCTION: Optical gaging gives you accurate, fast inspection of tools and dies during use in production.

For example, at *Stromberg-Carlson*, a Division of General Dynamics Corp., die life presented a complex gaging problem. Checking by conventional gaging methods was cumbersome, time-consuming, and inaccurate. Optical gaging of piece parts with a Kodak Contour Projector now provides a quick, accurate check of die wear during production. A typical example concerns a die which stamps out relay lever arms. The 35 dimensions of the lever arm are optically checked in 1/3 the time of other gaging methods.

Optical gaging with the Kodak Contour Projector saves time because you can check many dimensions at a glance. Saves you money, too, because one projector does a wide variety of gaging jobs. Changing from one type of part to another is a simple matter of changing your chart-gages on the screen and your fixtures.

Whatever your inspection or measuring problem may be, there's a Kodak Contour Projector to do the job—from the compact bench-type Model 8 to the big Model 30 with its 30-inch screen and large part capacity.

For additional details, send for the new illustrated booklet "Kodak Contour Projectors." Write to:

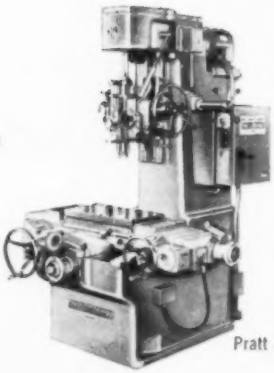
Apparatus and Optical Division

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

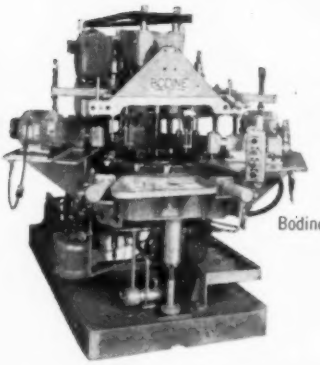
the KODAK CONTOUR PROJECTOR

Kodak
TRADE MARK

Hartford Special



Pratt & Whitney

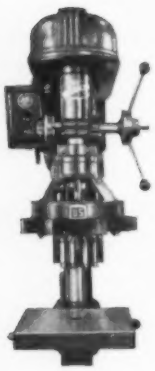


Bodine

17 LEADERS

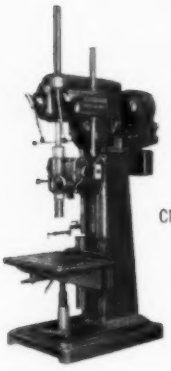
Stake their reputations on

JACOBS CHUCKS

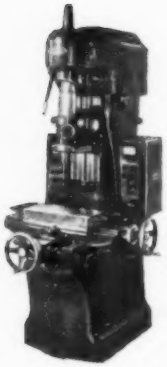


U. S. Drill Head

Greenlee



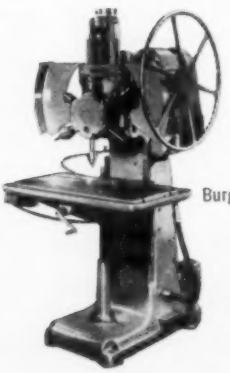
Cleereman



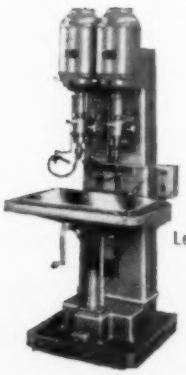
Moore

Dumore

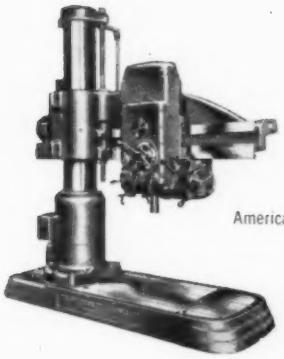
Snow



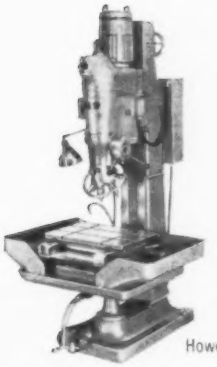
Burg



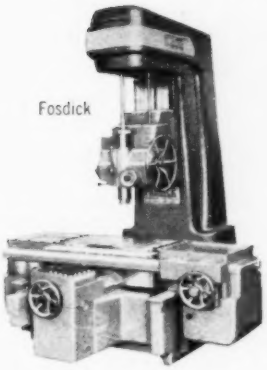
Leland-Gifford



American



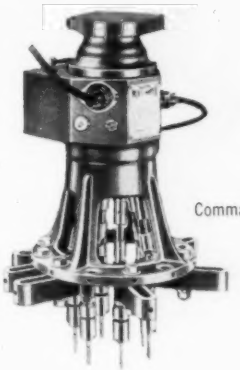
Howe & Fant



Fosdick

Chicago Quadrill

Jarvis



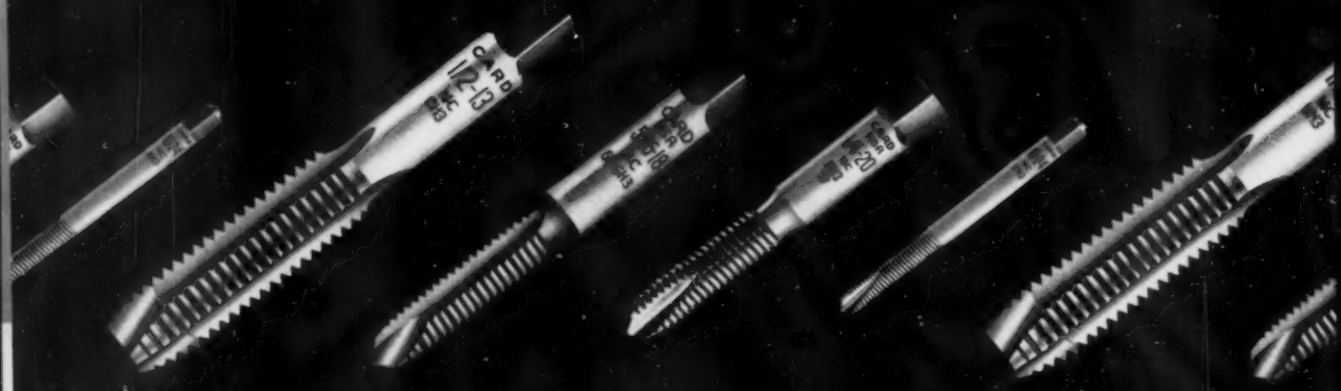
Commander

Jacobs and your industrial supply distributor are ready to deliver the chucks you need and the service you deserve. First in chucks . . . first in service.

The Jacobs Manufacturing Company
West Hartford, Connecticut

Jacobs
CHUCKS

As these desk phones are uniform



. . . So Card spiral pointed taps are uniform, too

Your production's consistent ...because Card taps are uniform

Your first step in consistent production performance is the cutting tool itself. Because Card spiral pointed taps are identical they keep production up to par — and predictable. Shopmen know about the uniformity of Card taps. Card gages are like that, foo.

S. W. CARD DIVISION, Mansfield, Mass. Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

The CARD Quality

CARD

DIVISION OF UNION TWIST DRILL COMPANY

— Serving you through the best distributors from Coast to Coast

If you use cutters as much as air tools use compressed air...

This brand cuts down your cutter usage, production time and costs!

The more you use cutters the more you need Union

Union cutters — best in design, materials and workmanship — provide consistent top performance and lowest cost per piece produced. Union makes solid milling and gear cutters, as well as inserted blade cutters — also drills, end mills, reamers, hobs and carbide tools.

Available nationally through Union Distributors and stocked in Union warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

UTD

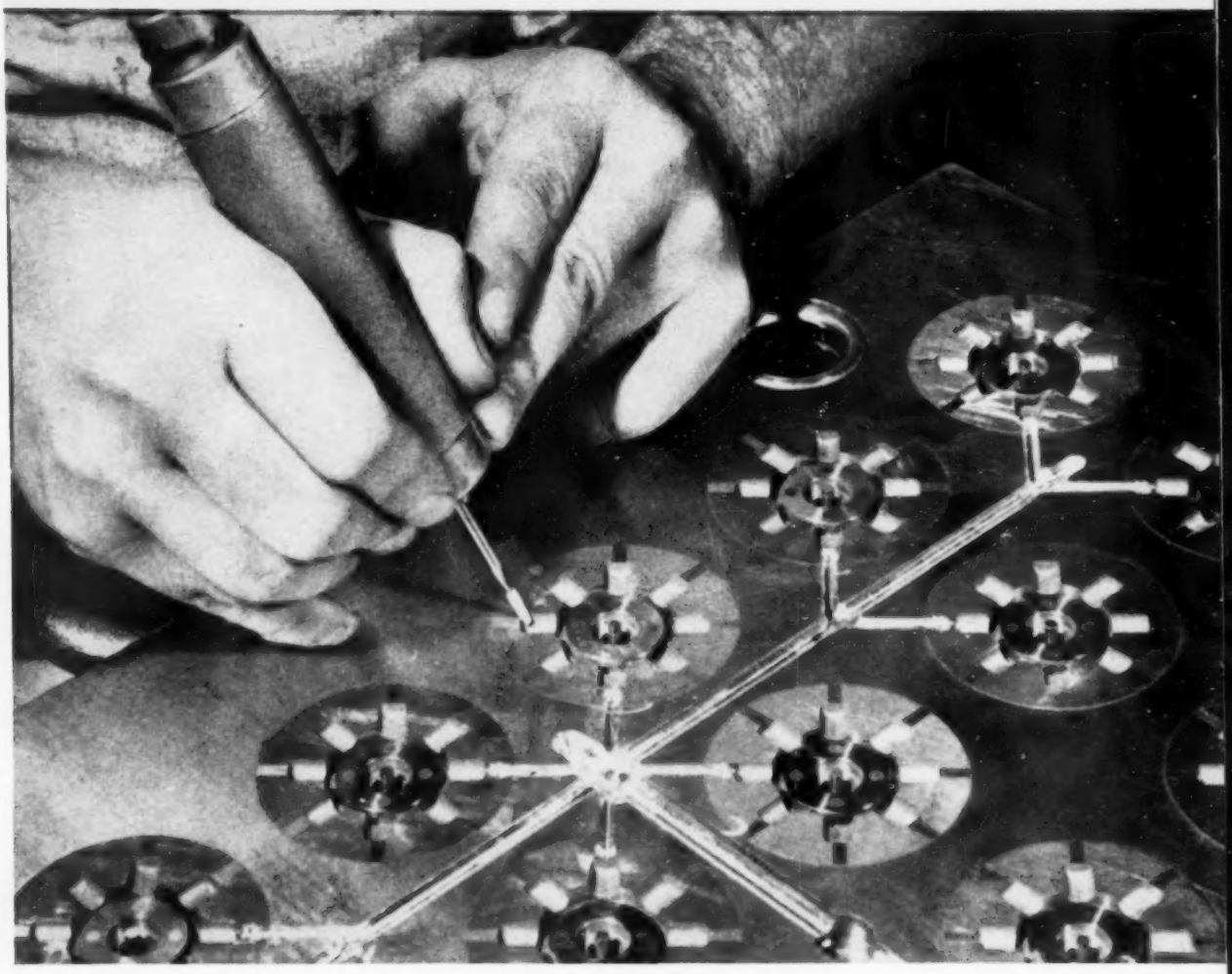
UNION

TWIST DRILL COMPANY, Athol, Massachusetts

S. W. CARD DIVISION, Mansfield, Mass.; BUTTERFIELD DIVISION, Derby Line, Vt.

See Your UNION DISTRIBUTOR for cutting tools that will save you time and money

32 ALUNDUM* Abrasive for your tool and die jobs



Here's how Norton keeps

"Making better products... to make your products better"

Our motto is constantly being proved by our customers. Norton mounted wheels, for example, are hitting new highs in grinding efficiency. Outstanding new developments in abrasives and wheel construction eliminate loading and glazing, assuring best possible results in:

TOOL AND DIE GRINDING

Norton mounted wheels with sharp 32 ALUNDUM abrasive and VBE bond are the very best performers.

Advantages: Wheels need no costly dressing, hold form and give constant cutting action from start to finish — right down to the mandrel. "Best I ever had," reports a long experienced die finisher.

ROUGH GRINDING

For steel castings and weldments, mounted wheels of tough 44 ALUNDUM abrasive with VBE bond, and metal-mounted, are unequalled.

For snagging cast iron, wheels of sharp 32 ALUNDUM abrasive with VBE bond, and metal-mounted, outperform silicon carbide wheels consistently.

Advantages: Norton wheels give you the fastest cutting rate, with a marked increase of stock removed per wheel. "There has never been anything like them for speed and economy in our snagging," says the foreman of a leading foundry.

32 or 44 ALUNDUM Abrasive for your rough grinding

METAL-MOUNTING — *Another Norton Exclusive — You throw nothing away but the mandrel!*

Norton does it again! The mounted wheels are so securely anchored to the mandrel — *you use all of the abrasive!* No waste . . . all work! This radically improved method of locking the abrasive body to the mandrel is used on mounted wheels in most sizes and shapes, 5/16" diameter and larger. Molten metal, injected into the abrasive recess at high pressure, does it — and does it fine!

Every Norton mounted wheel is accurately trued *after mounting* on rust-proof stainless steel mandrels. Developed to increase the time-and-money-saving "Touch of Gold," Norton mounted wheels are stocked in approximately 200 standard shapes and sizes. See your Norton Distributor for prompt deliveries. Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON
ABRASIVES

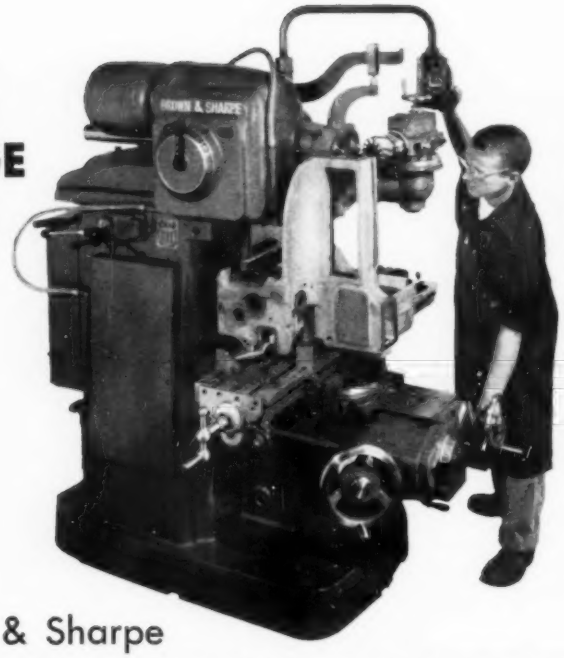
W-1879

Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

'way out ahead in WORK RANGE –in OPERATING ECONOMY

For tools, dies, molds, for prototype work, for maintenance, for any milling job–



COMPARE this capacity!

28" Table feed
12" Transverse feed
25" Face of column to center line of vertical spindle
20½" Vertical feed
3½" Hand movement of quill in universal head.

Spindle Speeds
Horizontal Spindle
40 to 1530
Universal Head
80 to 3060

The Brown & Sharpe RANGEMASTER

Universal & Plain Milling Machines — sliding head type

LOWER ORIGINAL INVESTMENT

On the RANGEMASTER you can take No. 2 size cuts on work pieces whose physical dimensions would normally require the capacity of a more expensive No. 3 or larger size machine.

LOWER SET-UP AND OPERATION COSTS

With the RANGEMASTER you *clamp the work piece once*, then machine all around it – mill, drill, or bore from any angle. You avoid relocating and re-alignment, with consequent risk of errors. You get more hours of machining time, and minimize set-up time.

LOWER TOOLING COSTS

In the RANGEMASTER, both horizontal and vertical spindles have the same standard No. 40 M.M. taper for interchangeability of tooling. One set of tooling serves for multiple operations. There's no need for costly compounding of tool inventory.

Compare all the features of the RANGEMASTER, Universal or Plain Type, and you'll agree it's by far your best buy in its class. For details, write: Brown & Sharpe Mfg. Co., Providence 1, R. I.

ALL THE ADVANTAGES OF A "RAM-TYPE" MACHINE WITH NO SACRIFICE IN CUTTING ABILITY

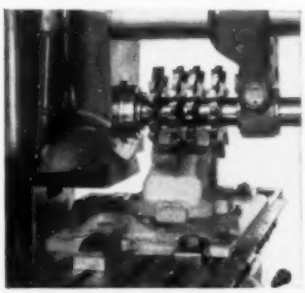
In the Rangemaster, all the following features are the same as in a conventional knee-type milling machine of corresponding size:

SAME SPINDLE MOUNTING –

SAME SIZE "BULL" GEAR –

SAME RANGE AND NUMBER OF SPINDLE SPEEDS –

SAME DIRECT DRIVE to both spindles, utilizing full power



Positioning of sliding head adjacent to the work piece permits mounting of cutters close to spindle nose for improved cutting ability.

PROGRESS IN PRECISION FOR 125 YEARS

Brown & Sharpe BS

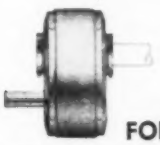
MILLING, GRINDING, AND SCREW MACHINES • MACHINE TOOL ACCESSORIES • PRECISION TOOLS • HYDRAULIC PRODUCTS • CUTTERS

DETACHABLE MOTOR DESIGN
permits motor change in minutes
— avoids downtime for motor repairs.

Now - a MOTORIZED SPEED REDUCER FOR MOUNTING DIRECTLY ON SHAFT

the NEW BOSTON Gear® OPTIMOUNT TRADEMARK

HELICAL GEARED
REDUCTORS • RATIOMOTORS
AND FLANGED REDUCTORS



FOR SHAFT-MOUNTING . . .

IT'S THE NEW OPTIMOUNT

Ratiomotor for shaft mounting. It's the compact power package you have needed to save space without sacrifice of top transmission efficiency. Single or double reduction helical geared units deliver 87.4 to 431 output RPM. Get details—find out how OPTIMOUNT can solve your drive design problems.

OR IN STANDARD BASES FOR ANY FLOOR, WALL, OR CEILING MOUNTING POSITION

You can meet any drive conditions with OPTIMOUNT by using standard models *from stock*. Standardized, interchangeable parts permit easy adaptation to different drives. You save time in installation and maintenance, and reduce plant inventories of various types of speed reducers.

OPTIMOUNT delivers maximum power, with highest efficiency, through precision-finished helical gearing made to BOSTON Gear quality standards. Get details from your Distributor. He will demonstrate the many features that assure OPTIMUM PERFORMANCE. Boston Gear Works, 83 Hayward St., Quincy 71, Mass.

66 MODELS
FROM STOCK

680 OPTIONAL MOUNTING ARRANGEMENTS

1/6 to 15 H.P. DRIVES

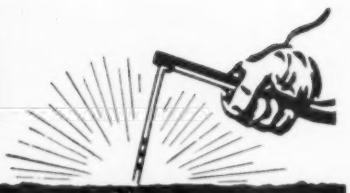
For nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

CALL YOUR BOSTON Gear DISTRIBUTOR

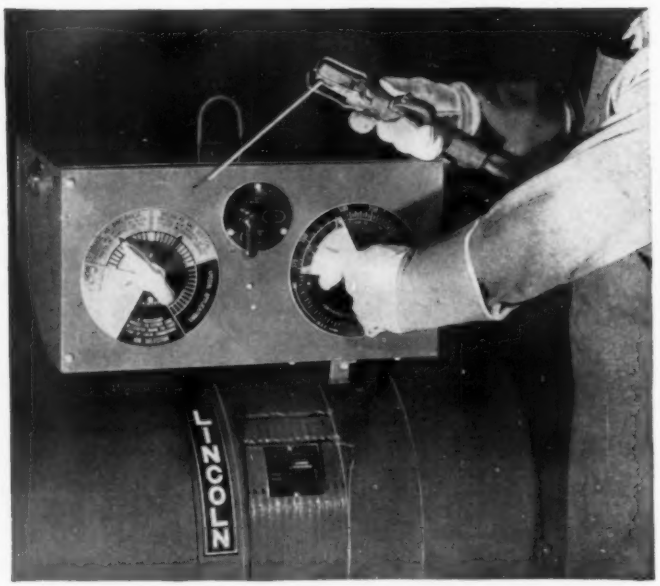
NEW CATALOG OP-1 lists complete OPTIMOUNT data—selection charts, application information.

Remember — STANDARDIZATION PAYS —

Weldynamics



ARC WELDING AT WORK CUTTING COSTS



In Your Shop you can take advantage of Weldynamics by providing your weldors with the most efficient equipment.

Lincoln Shield-Arc Motor-Generator Welders are Weldynamically designed for fast, easy welding under any conditions.

Dual Continuous Controls allow the weldor to select the kind of arc he likes to work with. He uses the current control to select the welding heat, and the voltage control to select arc "snappiness" and to fine-tune the welding heat.

Nearly Every Weldor is familiar with Lincoln Shield-Arc Welders, and most weldors prefer them.

Lincoln Applies Weldynamics in its own plant to cut manufacturing costs. These savings are passed on to you in better welding products for less cost.

Lincoln Representatives are trained in Weldynamics. They are equipped to help you with procedures, equipment and design. A letter or phone call is all it takes.

Shield-Arc motor-generator welders are available in 200, 300, 400 and 600 amp sizes; portable or stationary; for AC or DC power supply. Specifications and engineering data are contained in Bulletin SB-1362. Sent on request.

The World's Largest Manufacturer of Arc Welding Equipment

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LINCOLN

THE LINCOLN ELECTRIC COMPANY • DEPT. 5023 • CLEVELAND 17, OHIO

. . . for Precision and
Economy Production

- SPUR GEARS
- SPIRAL GEARS
- WORM GEARS
- WORMS
- BEVEL GEARS
- INTERNAL THREADS

MIKRON

Universal GEAR HOBBER #102

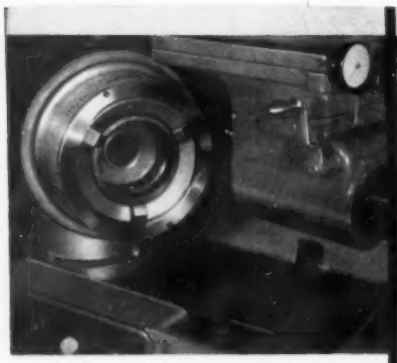
Easy to set-up.
Easy to change-over from job to job.
Simple to operate!

CAPACITY (standard machine):

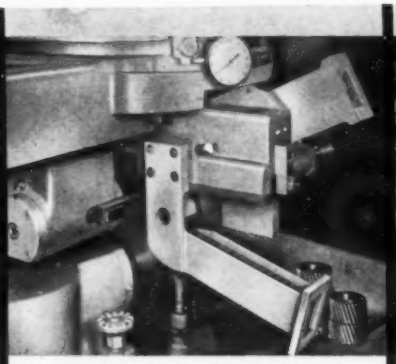
Spur or spiral gears, max. dia.	4 3/4"
Max. length of cut	5 1/8"
Number of teeth from 6 to 325	
Lead of spirals from 3/4 to 174"	
Angle of right or left spiral	from 0° to 90°
Max. pitch	DP 12

RUSSELL, HOLBROOK & HENDERSON, INC.

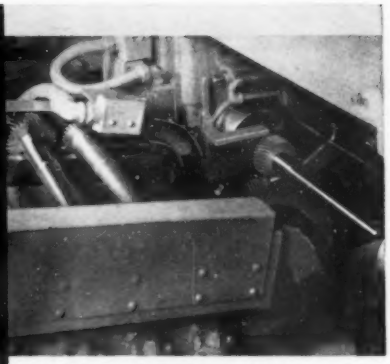
292 Madison Avenue, New York 17, N. Y.



INTERNAL 870-C, only vertical internal shaver where a heavy mass (chuck and gear) drives the cutter. Reversals impose no abnormal loads on cutter teeth. This prevents excessive cutter breakage. Extras—plunge shaving.



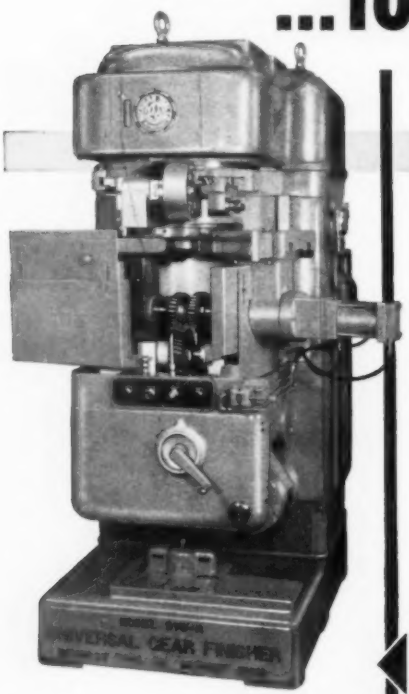
UNDERPASS 870 Gear Finisher for fastest shaving—long or short run—of spur, helical, herringbone or shoulder gears. Extras—the new knee, new cutter-saving drive, crowning cutters, easy to set up and operate.



READILY AUTOMATED—Michigan 870 and 870-A shavers can be partly or fully automated. They are the only vertical shaving machines featuring 'straight-through' automation. They can be automated to load or unload from front or back.

TO GET BETTER GEARS AT LOWER COST

...look for the extras



Michigan's latest 870-series Gear Finishers are loaded with EXTRAS. A new knee assembly brings all controls to the front—and puts the operator closer to the work. Operators like ease of setup, vernier and dial locating, and the simple locking. Work located above cutter makes manual loading safer, automatic loading easier. Machine ways are up out of the way of contamination by chips or foreign matter. Timken bearings, extra-rugged fully splined shafts and a shock-absorbent drive, provide a sturdy no-backlash drive. Starts and stops are cushioned to keep cutters operating longer. Every installation has the EXTRA of being individually Michigan Application Engineered to cut costs.

Write for descriptive literature.

***UNIVERSAL 870-A** (with new knee) permits adjustable automatic upfeed to be used with any of the three basic shaving methods. Extras—faster approach, longer tool life. Optional crown shaving attachment (permits shaving of a series of gears with varied crowns using only one tool).*

May we have the Michigan Tool engineering representative in your area show you how Michigan gear finishing can make your geared parts even better.

MICHIGAN TOOL COMPANY

from blank to finished gear

7171 E. McNICHOLS RD., DETROIT 12, MICH., U.S.A.
IN CANADA: COLONIAL TOOL CO. LTD.

Genuine ALLENs for your king-size holding jobs now available from stock!

1¼" and 1½" sizes are standard

These applications show you the great variety of holding jobs for which designers and engineers are specifying these rugged king-size Allen Hex-Socket Cap Screws. They're genuine Allens, from their heads to their Leader Points. Pressur-formd, to preserve the long fibers uncut throughout their lengths. Highly accurate threads. Leader Points, of course—for fast, true starting. 1¼" and 1½" diameters available immediately from stock—larger diameters are available on special order.

PHOTO: THE OILGEAR CO.

King-size Allen Hex-Socket Cap Screws are used to secure the flanges in this big 12-inch 3000 psi Oilgear Surge Valve.

PHOTO: GOODMAN MFG. CO.

King-size Allens secure cutter arms, tilting arms, and elevating cylinders in this massive Goodman Continuous Mining Machine.

PHOTO: SODERHAMN MACHINE MFG. CO.

King-size Allen Cap Screws securely clamp the knives of this large and unusual machine that debarks whole trees.

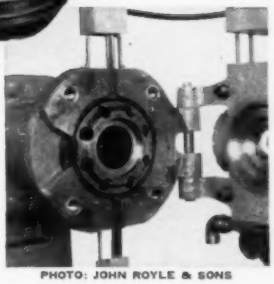
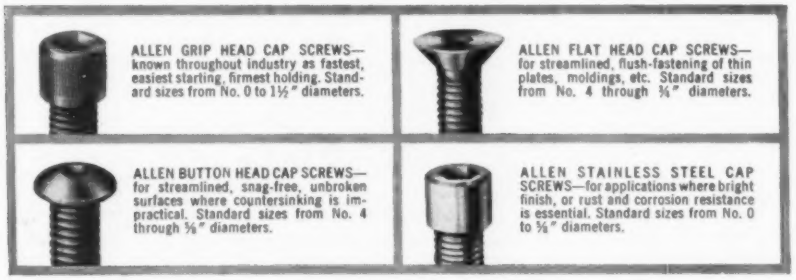


PHOTO: JOHN ROYLE & SONS

King-size Allens in the side-delivery Extruding Head of this Royle machine for application of rubber or plastic in solution.

The cost of Allen Hex-Socket Cap Screws is only a minor fraction of your assembly costs . . . be sure you're getting the timesaving, cost saving advantages of genuine Allens!



ALLEN GRIP HEAD CAP SCREWS—known throughout industry as fastest, easiest starting, firmest holding. Standard sizes from No. 0 to 1½" diameters.

ALLEN FLAT HEAD CAP SCREWS—for streamlined, flush-fastening of thin plates, moldings, etc. Standard sizes from No. 4 through ⅜" diameters.

ALLEN BUTTON HEAD CAP SCREWS—for streamlined, snag-free, unbroken surfaces where countersinking is impractical. Standard sizes from No. 4 through ⅜" diameters.

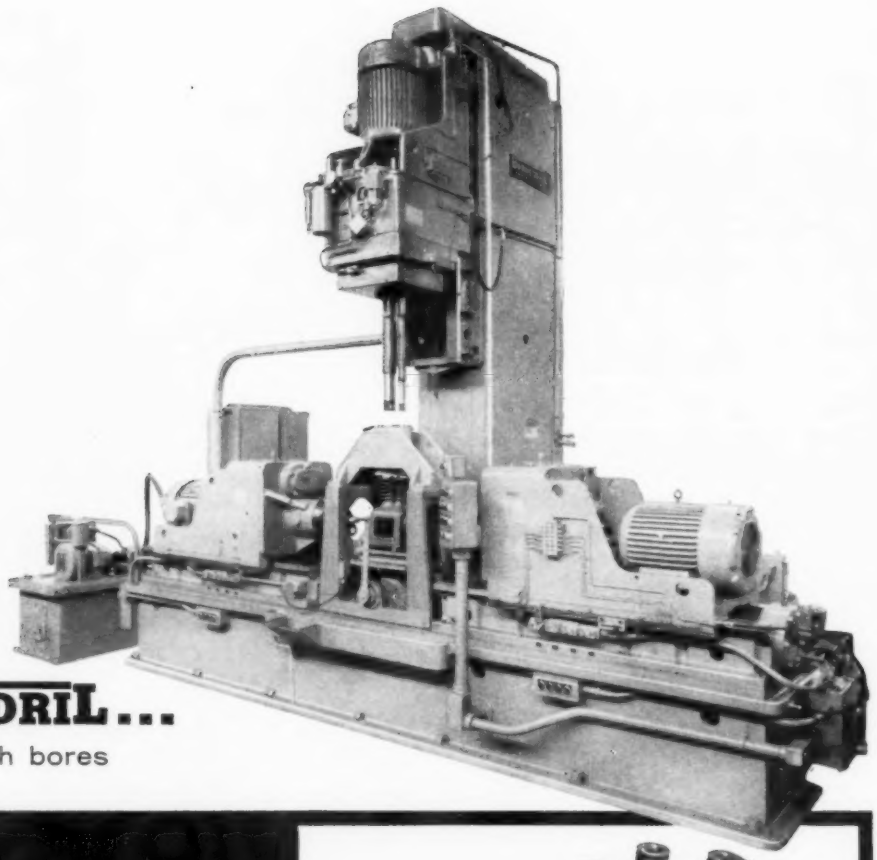
ALLEN STAINLESS STEEL CAP SCREWS—for applications where bright finish, or rust and corrosion resistance is essential. Standard sizes from No. 0 to ⅜" diameters.

FREE! . . . this new "vest-pocket" size Allen Hex-Socket Screw HANDBOOK . . . 112 pages of up-to-date technical information . . . Send for your free copy today.

ALLEN MANUFACTURING COMPANY
Hartford 2, Connecticut, U. S. A.

Stocked and sold by leading industrial distributors everywhere

ALLEN HEX-SOCKET SCREWS HEAD



BARNESDRIL...

rough and finish bores

10 different parts on one machine

These are samples of ten different crankcases, rough and finish bored on the same special Barnesdril 3-Way Unit Machine. This machine is engineered to handle all parts, using 2 fixtures with interchangeable top and lower plates. Machining flexibility is arranged through one single spindle adapter-type boring heads and five 2-spindle boring heads.

Such production flexibility furnishes a high rate of parts production, with minimum cost per part. Changeover part to part is simple and fast, either by changing complete fixture or substituting plates or spacers, with suitable boring heads. Machining *both* rough and finish bores of ten *different* parts on the one machine cuts direct labor and machine costs.

If you have parts requiring high speed automatic production, consult Barnesdril engineers for methods combining a number of different parts on a single machine. A full range of cycle operations are available, with cycle time engineered to meet production requirements. Send parts or prints for estimate.

The facts are free... complete data on production flexibility obtained with Barnesdril special machines is found in this new Bulletin 150G You may have a copy free upon request on company letterhead. Send for one today.

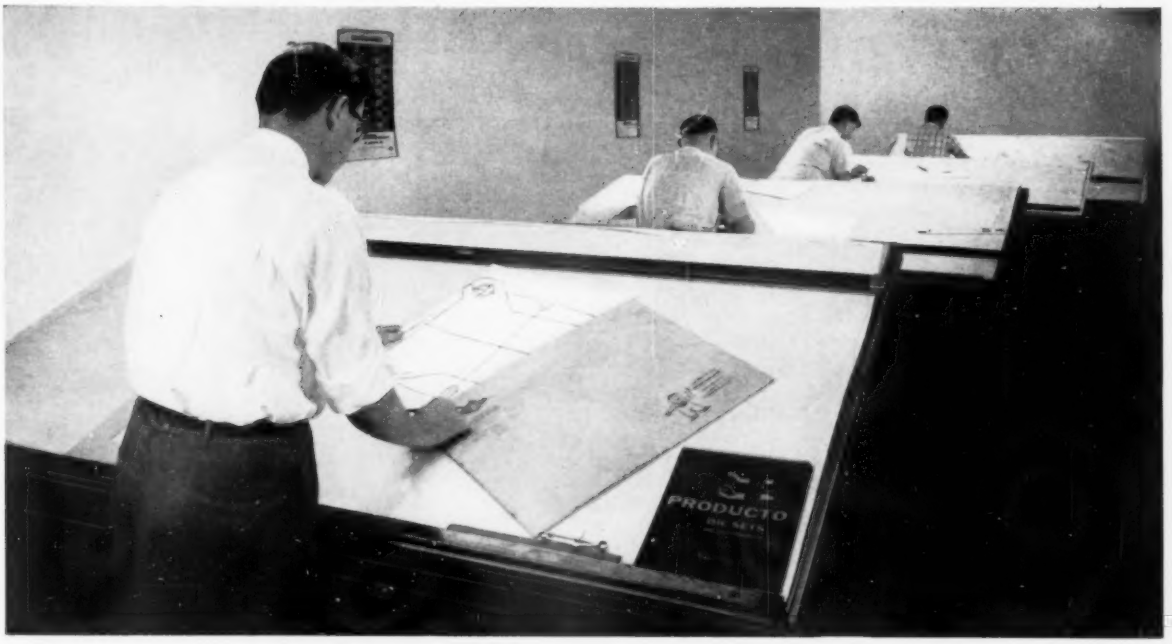
HOLE BARNESDRIL FINISHING

BARNES DRILL CO.

870 CHESTNUT STREET • ROCKFORD, ILLINOIS

DETROIT OFFICE: 13121 Puritan Avenue

Why the Die Designer Prefers PRODUCTO Die Sets



He can specify Producto with complete confidence

The die designer likes to specify Próducto die sets on his blueprints because they are a nationally-accepted "brand." They're easy to get anywhere... and delivery is prompt.

He favors Producto because he knows he never has to compromise his die design. Even if the die layout is a little unusual, he will be able to select a die set to accommodate it from Producto's wide range of thicknesses and styles.

He also knows Producto has the equipment that can cut his tooling costs by letting him adapt his sets to a more economical *basic* design. Only Producto offers him complete foundry, pattern-making, welding and machining services for his special requirements.

The die designer recognizes Producto's Qwik-Fit Guide Pins as an important new feature that die makers want. He specifies them because they save up to 75% of the time normally required for die set assembly and disassembly.

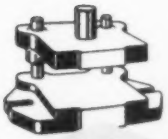
The die designer likes to use Producto's new catalog, the industry's most practical tool. His die layout is simplified when he uses Producto die set templates. And Producto provides him with cost-saving ideas in the DIE SET DIGEST.

Most important, he can depend on *consistent* Producto die set accuracy to transfer from the drawing board to the press the precision and ingenuity of his die design.

Yes, the designer has found that Producto die sets justify his confidence in specifying Producto. You will, too.

TWO FREE AIDS to more economical, efficient use of die sets are available from Producto. All-new CATALOG NO. 11 makes ordering and selection job easy. DIE SET DIGEST gives valuable tips for designers, builders and users of dies. Write for them today.

THE PRODUCTO MACHINE COMPANY
930 Housatonic Ave., Bridgeport 1, Connecticut



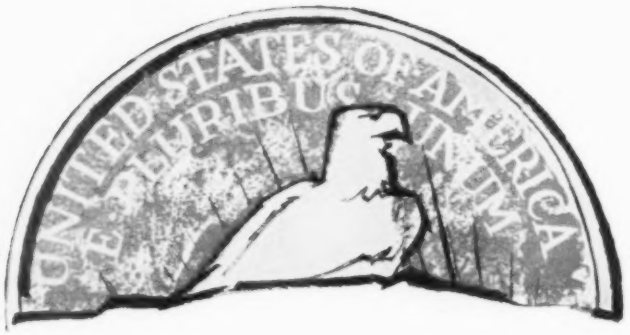
Wherever die sets are used

PRODUCTO

PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-55

Why pay a premium for lightweight tooling metals?.....



DOW MAGNESIUM TOOLING PLATE

.....costs up to 1/3 less!

It costs less for you to buy because you don't pay premium prices for tolerances you may not need. The fundamental characteristics of magnesium permit rolling and oven thermal flattening to a degree of flatness and surface smoothness satisfactory for virtually all tooling uses. This flatness is not obtainable in other lightweight tooling materials without costly machining of the surface.

Magnesium saves dollars after you buy it, too. It's the easiest tooling metal to cut, machine and weld —and, of course, magnesium jigs and fixtures are the easiest to handle. Add to this the durability, soundness, and dimensional stability which magnesium offers, and you have a lightweight tooling metal which cannot be equalled.

Investigate, and you will find that magnesium COSTS LESS TO BUY, COSTS LESS TO FABRICATE, COSTS LESS TO USE. Let a Dow magnesium supplier show you these savings in dollar and cents figures. Contact him today or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. MA 1429A-2.

AVAILABLE FROM STOCK AT:

Copper and Brass Sales, Inc., Detroit, Michigan
Fullerton Steel and Wire Co., Chicago, Illinois
Hubbell Metals Inc., St. Louis, Missouri
A. R. Purdy Co., Inc., Lyndhurst, New Jersey
Reliance Magnesium Company, Los Angeles, California
Vinson Steel and Aluminum Co., Dallas, Texas

SEE THE DOW DISPLAY at the Philadelphia ASTE Show, May 1-8, Booth 1653.

YOU CAN DEPEND ON DOW

"HIGH QUALITY EPOXY TOOLING AT LOW COST"

AVCO *Speeds ICBM Nose Cone Development With Unique Checking Tools Made of*

RCI Epoxy Resins and Polyurethane Foam

"In producing experimental missile components, we need a fast, foolproof and economical method of checking accuracy. And Reichhold EPOTUF epoxy resins have played a major role in our development of just such checking units."

Speaking is Mr. Bob Thompson, Plastics Project Leader, Experimental Manufacturing Department, AVCO Research and Advanced Development Division, Lawrence, Massachusetts.

AVCO's experimental work on the Titan ICBM nose cone is a vital, high priority project. Complex parts must meet exact tolerances. The slightest imperfection might cause failure.

For instance, one length of pipe for the nose cone twists and turns sixteen different times in its 34-inch length. To test the accuracy of each bend, AVCO has developed tools such as you see above made of RCI epoxy resins and RCI polyurethane foam. Such devices can be made quickly and inexpensively, and solve one of AVCO's toughest testing jobs.

"Furthermore, another benefit we gain in dealing with RCI is invaluable technical aid," Mr. Thompson stated. "Also we have never experienced any delays in delivery ... and we absolutely need this kind of service."

Perhaps dependable, versatile RCI EPOTUF epoxy resins or RCI POLYTOEL plastic tooling compounds will improve *your* application. Write RCI for details.

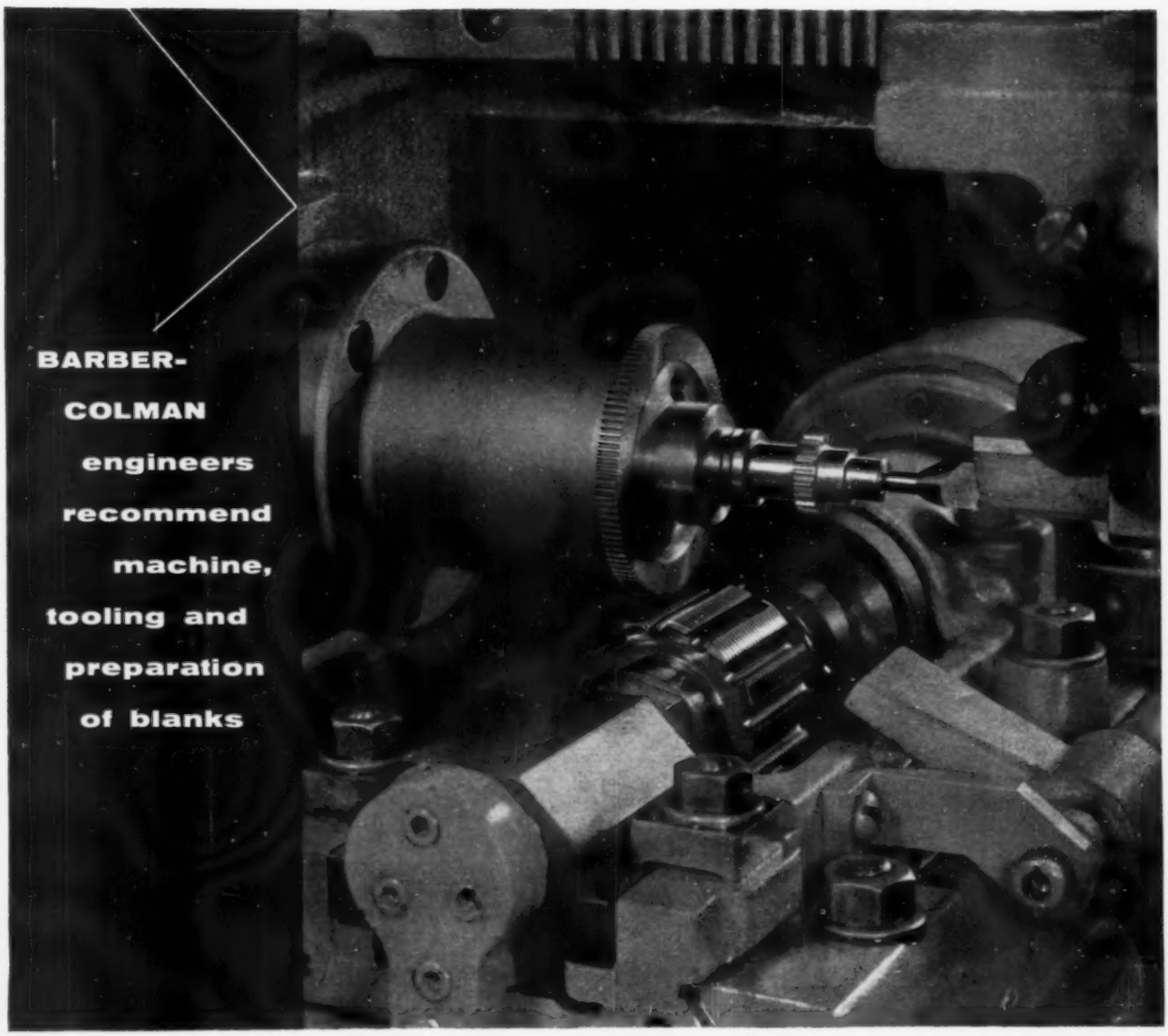
REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol
Hydrochloric Acid • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Ortho-Phenylphenol • Sodium Sulfite
Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

Creative Chemistry ...
Your Partner in Progress

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N.Y.

GUARANTEED ACCURACY
with standard-type precision
hobbing machines



The Kearney and Trecker Corporation have designed a servo-control mechanism for controlling an airframe section profile and contour milling machine. The extreme accuracy required for the transfer of motion in this mechanism demanded a whole new approach to the production of gears at Kearney and Trecker.

Barber-Colman Engineers were consulted for their suggestions to assure gear accuracy for this program. They recommended a standard-type No. 6-10 Precision Hobbing Machine and designed special tooling for each of the eight gears in the mechanism. They also specified the preparation of the blanks for hobbing.

This machine is guaranteed to cut a 4″ diameter spur gear within .0002″ adjacent and .0004″ non-adjacent spacing error checked on an optical dividing head. The blanks are ground on the diameter and sides, holding the diameter, parallelism and radial and axial runout within .0001″. Two holes are provided for driving the gear during hobbing.

These photographs show one of the gears in the train and the special tooling designed for it. The blanks are located between centers and are driven by a diamond-shaped pin in the backing plate. For hobbing this 48 D.P., 115 tooth gear, a feed of .010″ is used, and the hob speed is 183 R.P.M. The material is stress-proof steel R.C. 27. Barber-Colman Class AA taper-bore hobs are used and resharpened to original hob accuracy on a Barber-Colman No. 6-5 Hob Sharpening Machine.

With this equipment and recommended procedure, all gears in the train are hobbed well within Precision Class 2 AGMA tolerances. The success of this program is indicated by the results obtained on the example shown. Inspection shows these gears are consistently within .0002″ tooth-to-tooth and .0004″ total composite error.

Accuracy of this degree is not unusual with Barber-Colman machines and hobs. This case shows the results which can be obtained by working closely with, and following the recommendations of, experienced hobbing technicians. When you have applications requiring accurate gears, consult Barber-Colman hobbing experts for their recommendations.

BARBER-COLMAN COMPANY

6810 ROCK STREET • ROCKFORD, ILLINOIS

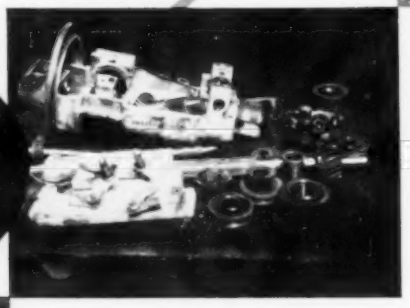
Hobs • Cutters • Reamers • Hobbing Machines • Hob Sharpening Machines

BARBER COLMAN

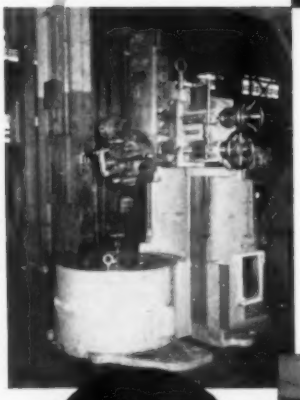
BULLARD

rebuilds from the ground up

Yes — we disassemble each machine right down to the bed.



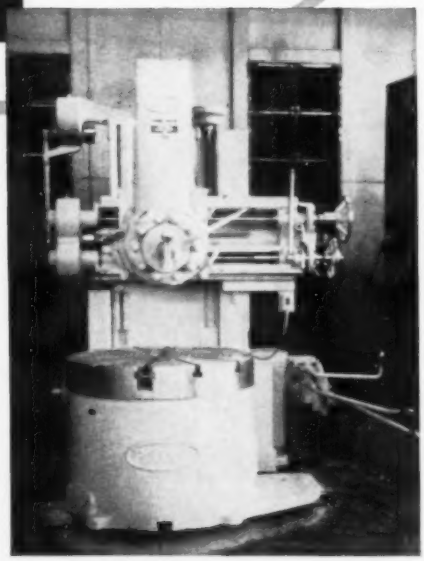
Each individual piece is cleaned and inspected



and if found serviceable is re-used, if not, it is replaced.

What does this mean to You?

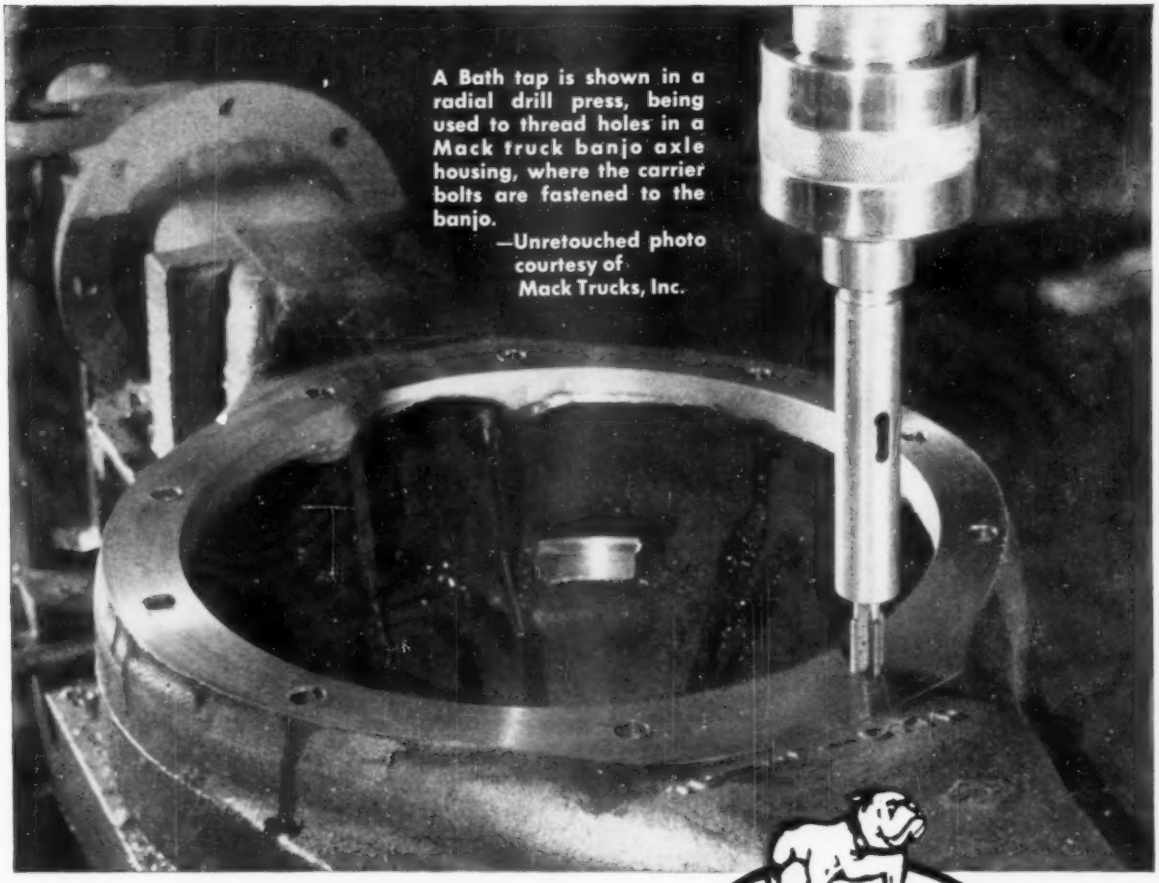
1. Thorough workmanship by the same skilled craftsmen that built the machine.
2. Only "original equipment" precision replacement parts, where necessary.
3. Fast service.
4. One year guarantee on all parts replaced — including labor.



If you're planning to rebuild any of your Bullard machines contact your nearest Bullard Sales Office or Distributor for a quotation or write

BULLARD

THE BULLARD COMPANY BRIDGEPORT 9, CONNECTICUT



A Bath tap is shown in a radial drill press, being used to thread holes in a Mack truck banjo axle housing, where the carrier bolts are fastened to the banjo.

—Unretouched photo courtesy of Mack Trucks, Inc.

Another Bath Tap job well done for . . .

Mack TRUCKS

For many years the phrase "built like a Mack truck" has been commonly used to express strength and dependability.

This reputation for dependable transportation involves a policy of quality control in manufacture which starts with the selection by Mack of the finest working tools . . . such as "ground from the solid" Bath taps for threading axle housings.

Here is what this long-time user of Bath taps has to say:

"The Mack Allentown factory has used this tap process (pictured) for more than 20 years with results that show excellent uniformity."

If you have a threading problem—let us know the kind of material, the type of tapping machine used, the kind of fixtures and lubrication involved. With this information, our engineers will be glad to help you . . . may be able to bring about increased production and more uniform results.

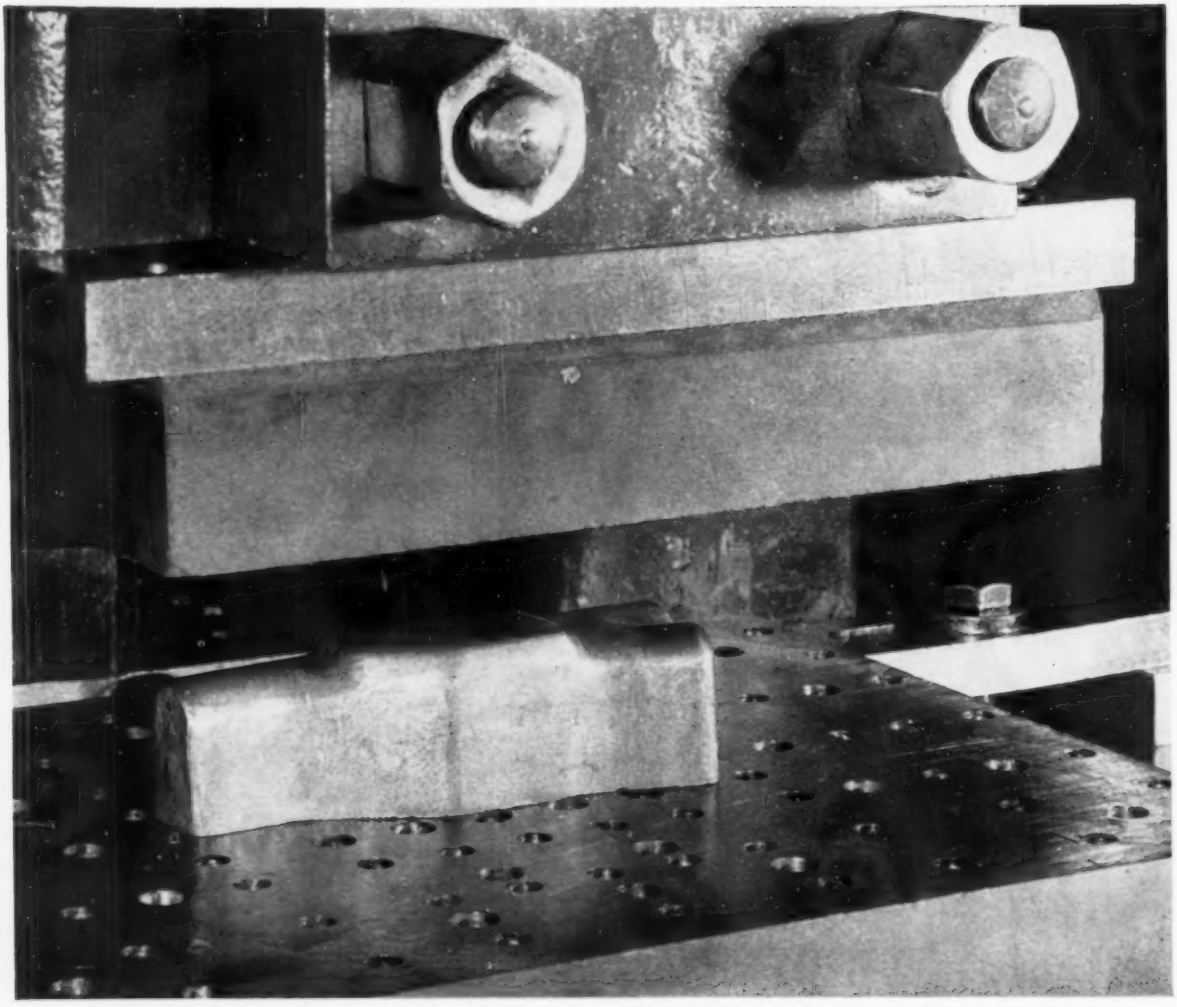
for the best buy ...buy Bath

JOHN BATH & CO., Inc.

28 Mann St., Worcester, Mass.

CYLINDRICAL AND THREAD GAGES · GROUND THREAD TAPS · INTERNAL MICROMETERS

3M CHEMICALS *3M Chemicals opening new worlds of use for stamped metal*



Resin die shakes off 85-ton punches!

Tough 3M Brand compound cuts short-run metal-stamping costs

The die is cast for real economy in short-run metal-stamping operations—even in cold roll, complex-contour steel stampings! With new 3M Brand Tooling Compound 113, you can make low-cost dies for punch and die presses up to 85 tons.

This tough, steel-based resin compound has extremely high impact strength; performs at the same production rates and efficiency as do steel dies. The result: economical tooling-up is practical for the first time for many short-run metal-stamping operations, or fabricating prototypes.

Tooling Compound 113 actually cuts tooling costs from 50% to 90%, compared to the costs of ordinary methods. The two-part system results in simple handling, fast drying and curing . . . all adding up to important savings in both time and material.

There's no more weighing and mixing, and you can return what material you don't use to its can. Pot-life and toxicity problems are eliminated. Preforms are fabricated from the treated steel powder, dried to good "green strength," then set in a pan of liquid resin for impregnation and cure.

Look to 3M Brand Tooling Compound 113 for top performance and economy on short runs—in the thousands! For full data, write: *3M Company, Dept. WS 48, St. Paul 6, Minnesota.*

HASTINGS CHEMICAL DIVISION • CHEMICAL PRODUCTS GROUP

MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

Don't Be Blinded By Price--

Always look for True Value!

Naturally price is a factor to be considered — a very important one, too — when you're weighing the quotations of various gage manufacturers.

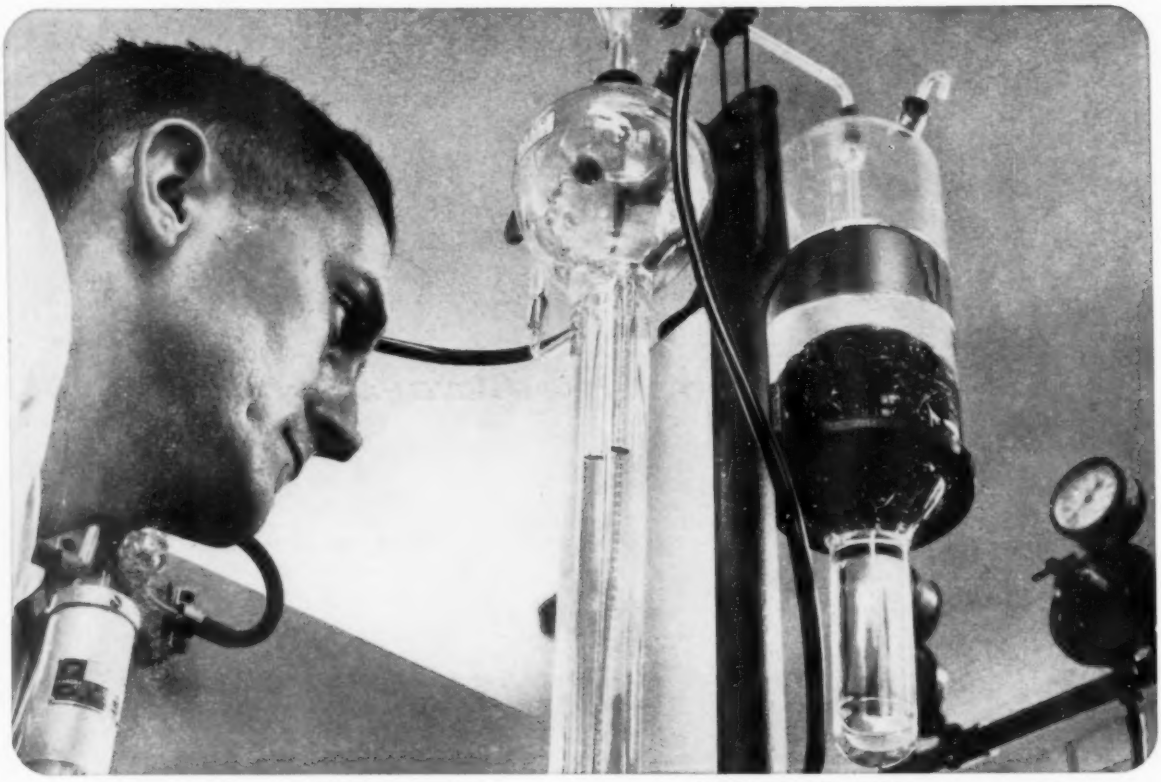
Don't let price be your only guidepost, however. Look beyond actual dollar and cent figures . . . be certain you're getting true value before you buy. Remember, the eventual cost of any gage depends on the reliability of your supplier, on the wear life and precision built into the gage itself and on the per piece inspection time required.

At Pipe Machinery our modern craftsmen are dedicated heart and soul to the theory that there's no substitute for quality, accuracy and service . . . that the best gage in the long run is always the most economical. For the highest precision — at a fair price — always look to Pipe Machinery. Whatever your time requirement, you can be certain you'll receive your order when you need it.

When you are in the Cleveland area, stop in and see us.

THE PIPE MACHINERY COMPANY • *29100 Lakeland Blvd.* • *Wickliffe, Ohio* • *Greater Cleveland*

***Experience**—the added alloy in **Allegheny Ludlum** tool steels*



QUICK, FAST TESTING for carbon content is done not once or twice but 8 times per melt in A-L's Chem Lab with this direct reading Leco carbon determinator.

Carbon content checked 8 times during melt to guarantee A-L tool steel hardenability

Lab tests for carbon eliminate your guesswork; provide high hardness, uniform hardenability, reproducible tool performance.

Because carbon has the greatest influence on hardenability, Allegheny Ludlum watches it carefully during the melt. Testing a specimen for carbon takes only a few minutes. Therefore, A-L checks for carbon content 8 times during the melt, and makes the necessary adjustments to insure accurate control of carbon. This control means Allegheny Ludlum can hold carbon content to a closer range than most customers specify.

Carbon control at Allegheny Ludlum assures you of precise response to heat treating. This control in the melt brings you predictable, *high hardness, uniform hardenability* and *reproducible tool performance.*

This is just one of the many things A-L does to insure high quality. Here are some others: close control over forging techniques, rigid temperature-time programming, careful testing of billets prior to processing to insure good surface and sound interior, control over annealing to give you the right hardenability for your exact machining operation, thorough metallurgical testing to insure top tool steel quality and meeting of your specifications.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

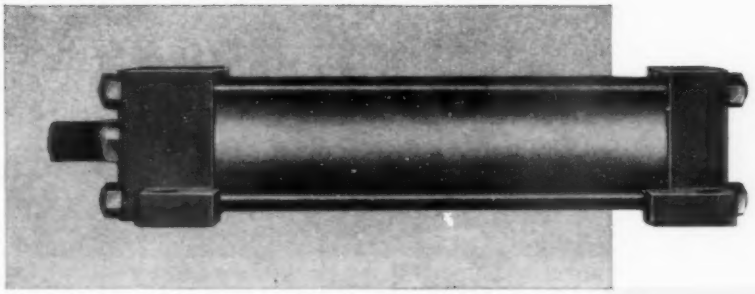
ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Bldg., Pittsburgh 22, Pa. Address Dept. TE-10

WSW-7261

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country... Check the yellow pages

every grade of tool steel... every help in using it

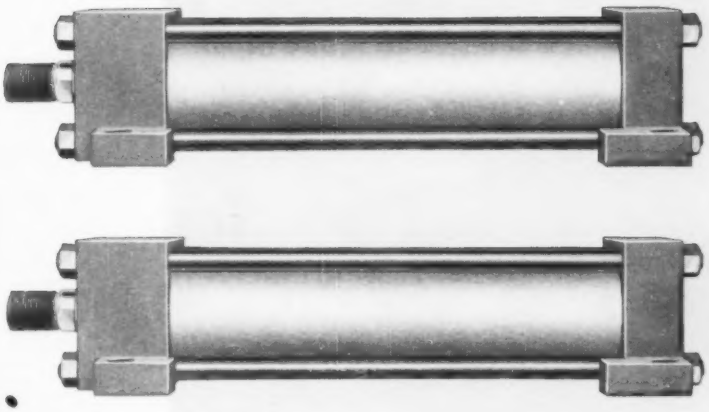


◀ A LOGAN SUPER-MATIC CYLINDER

2 competitors' cylinders

▼

do they LOOK ALIKE? ...sure they do on the surface...



...BUT LOOK AT Logan's BIG EXTRA PLUS VALUES

Logan Super-Matic Cylinders

are made to interchange with other leading manufacturers' cylinders . . .

1. Logan designs assure the service required for those extra-rugged applications.
2. Over FORTY YEARS of cylinder manufacturing know-how.
3. Built by CRAFTSMEN whose average service record with LOGAN is more than 20 years.
4. Manufactured in a plant which applies the most modern production methods.

FREE

SEND FOR THE "LOGAN CALCULATOR"

MEMBER: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.

LOGANSPORT MACHINE CO., INC.
839 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-6 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
- ☐ 200-2 ROTOCAST HYD. CYLINDERS
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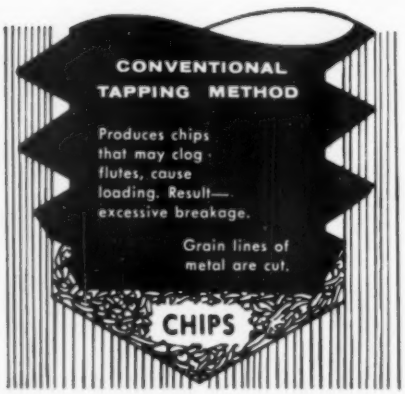
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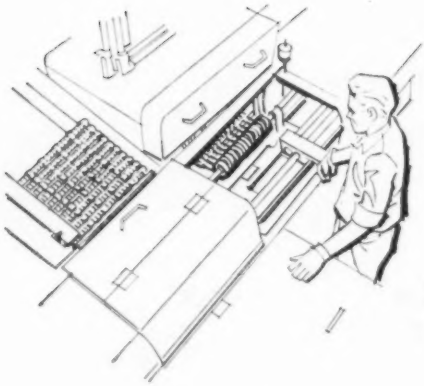

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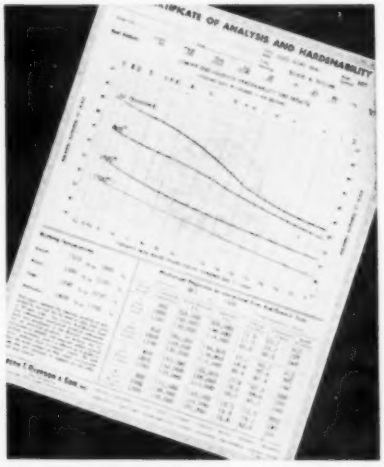

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ultrahigh speed MACHINING

...solution to producibility problems?

By Robert L. Vaughn
Producibility Methods Engineer
Lockheed Aircraft Corp.
Burbank, Calif.

As THE SPEEDS OF AIRCRAFT and missiles approach three times the speed of sound, aerodynamic heating causes conventional aluminum alloys to lose strength. Consideration is being given to insulation, refrigeration, sublimation or a combination of these as possible solutions to aerodynamic heating problems. The ideal solution is a light, strong material that can be machined, formed and cut with the same ease and speed as aluminum alloys, but which retains room-temperature strengths at elevated temperatures. Unfortunately, metallurgists advise that such a material will not be available in the foreseeable future. Therefore, tool engineers must learn to fabricate hardenable steel and titanium alloys that retain strength at elevated temperatures. In the not-too-distant future, these materials will constitute 20 to 40 percent of the structural weight of aerial vehicles.

In order to keep manufacturing costs in line, high-strength thermal-resistant materials must be machined by processes comparable in speed to conventional aluminum spar milling, skin milling and profiling. Use of forged, cast and extruded parts has eliminated some machining operations but does not eliminate machining completely. Some typical steel and titanium aircraft parts are shown in *Figs.* 1, 2 and 3. Their relatively complex configurations require considerable metal removal, even when they are partially preformed.

If present methods of machining are not improved, the increased use of new alloys will present a tremendous machining problem. In a report for the Air Research and Development Command, T. L. Taylor estimated that machining the increased quantities of high-strength thermal-resistant alloys by conventional methods would require at least four to ten times the machines, floor space and man hours now required for aluminum alloys. Today, aluminum alloys are being machined at extremely high speeds. High-strength aircraft materials, on the other hand, can be machined only at extremely low speeds, *Fig.* 4.

Machining Variables: The rate at which metal can be machined is affected by (1) size and type of machine; (2) power available; (3) cutting tool used; (4) material to be cut; and (5) speed. These five general variables can be broken down into:

A. Rigidity of machine, cutter and workpiece

B. Variations in speed from the slowest to the fastest, depending on machine used

C. Variations in feed and depth of cut from light to heavy and whether cut dry or with the aid of lubricant or coolant

Abstracted from Paper 164, "A Theoretical Approach to the Solution of Machining Problems" presented at the 1958 Semiannual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

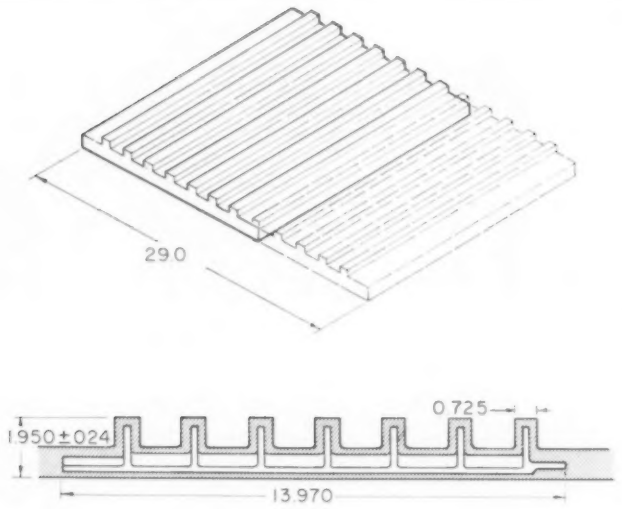


Fig. 1. Typical extruded aircraft wing panel. Shaded area is machined after extrusion.

D. Type and material of cutting tool

E. Variations in cutter shape and geometry

F. Type and physical characteristics of work material

G. Specific requirements of desired cutting speed, tool life, surface finish, horsepower required, residual stress and heat effects.

The one variable which apparently affects cutting efficiency the most is cutting speed. This variable, more than any other, is adversely affected by the advent of the new materials.

Aluminum alloys are now production-machined at cutting speeds as high as 15,000 fpm on special spar and skin mills. Hardenable ferrous and titanium alloys, on the other hand, are machined at 350 fpm in the annealed condition and at less than 100 fpm in the hardened condition. Most reported data shows that attempts to increase cutting speed using conventional equipment and cutters result in ruined cutting tools and high scrap losses.

These difficulties are apparently caused by high tool pressures and temperatures. The troubles occur regardless of the type tool materials used, although each type and grade has a different useful range.

Previous research on machining has been performed in three basic speed ranges. Research in the speed range slightly higher than current production speeds has contributed to the normal rate of improvement. Research in the next higher speed range has indicated a so-called "Valley of Death," where tool temperatures and cutting forces are abnomally high. Research at still higher speeds has indicated that at speeds beyond this "Valley of Death," tool temperatures and required horsepower have a tendency to drop.

The normal rate of increase in machining speeds will be entirely inadequate to compensate for the increased usage of the high-strength, thermal-resistant alloys. Just to maintain the present standards of producibility for the aeronautical industry, complete new concepts of machining must be explored and developed. The use of ultrahigh machining speeds offers a real solution to the problem.

Ultrahigh Speeds: On April 27, 1931, a German patent was issued to Dr. C. Salomon on methods of machining metals by ultrahigh machining speeds. Dr. Salomon made tests on nonferrous metals such as aluminum, copper and bronze, cutting at speeds to 55,000 fpm, using helical milling cutters with 8 to 20 teeth and various feed rates. Horsepower consumption varied between 6.16 and 17.6. As a result of these tests, his patent claimed that: "the method is characterized by the selection of cutting speeds in excess of 2000 to 2500 fpm and avoiding cutting speeds which are critical for both the work and the tool material, whereby a cutting motion is executed by the tool." The patent is based on curves of cutting speed plotted against generated cutting temperature and indicates that for any given set of conditions the heat generated by cutting follows a single-peak curve.

Other tests run in the United States and foreign countries have confirmed, in part, the benefits of high-speed machining. In recent tests with a 150-hp LeBlond lathe, 1045 steel was cut with a cemented oxide cutter at 18,000 fpm, producing surface finishes of 15 microinches with good tool life. Tests carried out in the Russian Machine Tool Research Institute in Moscow employing milling speeds of 20,000 to 28,000 fpm in milling of aluminum and bronze proved that the cutter did not wear

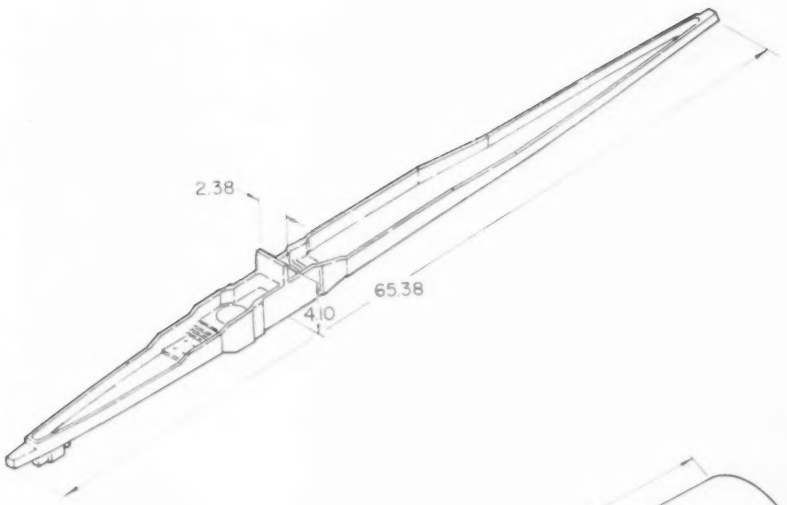


Fig. 2. Machined aircraft stabilizer rib. Material is low-alloy or corrosion-resistant steel.

at these speeds. Other reports state that increased speeds help to dampen vibrations, resulting in improved finishes and less cutter wear.

Some investigations relate surface waviness to machining speeds. Curves drawn from such tests are similar in form to Dr. Salomon's curves. It has been concluded that, under a given set of conditions, machining vibrations reach a maximum ampitude. When speeds are further increased, vibrations decrease and eventually vanish.

Researchers have recently found that many machining phenomena tend to become asymptotic as speeds are increased. Tests have been limited to speeds of only about 30,000 fpm, however, and it would be unwise to extrapolate the results. The behavior of metals exposed to energy absorption at high velocities is not too well understood.

Reasons for Metal Failure: It is known that failure of material is by slip due to shear forces or by brittle cleavage, whether in tension or compression: In crack propagation studies, only the propagation of tensile forces is ordinarily considered but, in conventional machining studies, interest is focused on fracture resulting from shear and compression forces ahead of the tool.

Two processes are involved in metal cutting: crack propagation by crystalline cleavage (rupture due to brittleness) and plane shear slip. There is a tendency in nometallurgical fields, however, to consider all failures (metal separations) that occur rapidly at relatively low applied loads to be brittle fractures. The brittleness is judged by apparent suddenness of rupture, measurement of elongation, or reduction of area, with little or no regard to the internal behavior of the metal.

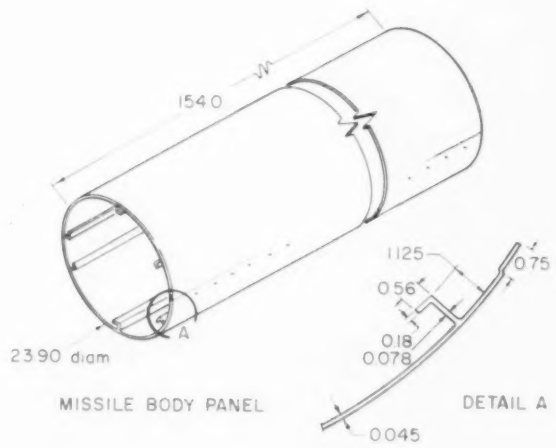


Fig. 3. Titanium alloy missile body panel is typical of the structures that must be machined from high-temperature alloys.

It is now fairly well agreed that brittle fractures are cleavage phenomena and ductile fractures are shear or slip-plane phenomena. The type of fracture may depend on the temperature, speed of loading, nature of applied stress (uniaxial, biaxial or triaxial), metallurgical structure and other factors.

Modern theories propose that cleavage failures are elastic wave phenomena and are propagated at extreme velocities (i.e., one-third the velocity of sound in the material). Failures involving shear are believed to be much slower, since shear propagation is affected by crystal structure, grain boundaries, subgrain and dislocation structure, any precipitants present and orientation. It has been stated that the velocity of shear is inversely proportional to the number of subgrain boundaries which must be traversed by shear failures. It does not appear that tensile forces are, or will be, developed during machining, either at conventional or at ultrahigh speeds. Therefore, fracture normal to the direction

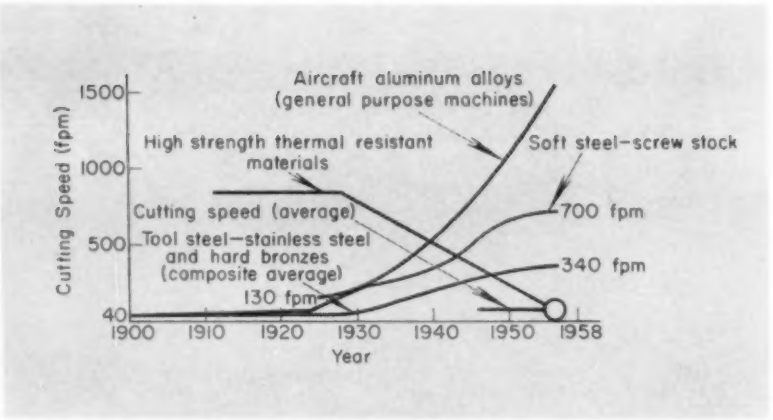


Fig. 4. Impact of titanium and other high-strength thermal-resistant materials on cutting speeds. Over the years, machining speeds have risen. With high-strength materials the trend is reversed.

of cutting cannot take place, and both plastic deformation (if this occurs) and fracture will take place by shear only.

Plastic Deformation: In 1942 Dr. Theodore von Karman introduced a theory on propagation of plastic deformation in solids. His work was for the purpose of understanding the resistance of structures against impact and involved tensile impact tests to velocities of 12,000 fpm. For simplification, the lateral motion of the material was neglected and the stress was assumed to depend only on the strain and not on the time rate of strain.

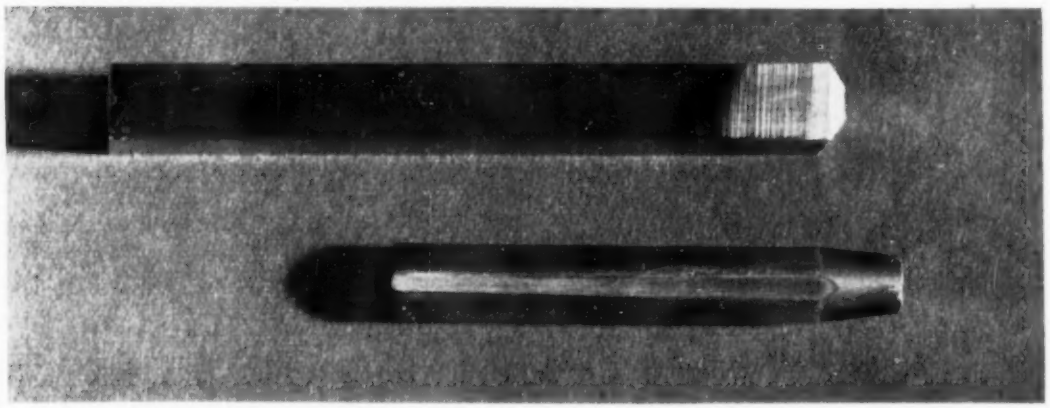
Basically the theory proposes that each material has its "critical velocity" of plastic wave deformation, which is a function of the stress-strain characteristics and density of the material. If a piece of material is subjected to an impulsive load with a force several times the breaking load at a speed equal to or greater than its "critical velocity," the piece will fracture instantaneously.

At relatively slow machining speeds, the material ahead of the tool is deformed by shear and compression forces, and the chip itself is crushed by compression. To extrapolate von Karman's theory: as machining speeds increase, the time for plastic deformation of the material ahead of the tool and crushing of the chip decreases. At or above the "critical velocity" the material does not have sufficient time for deformation and must fail in a brittle manner. This is just what is required for machining.

However, shearing strain rates from 10^3 to 10^6 in./in./sec. may be realized at conventional machining speeds while those involved during the tensile impact tests mentioned were judged to be much lower in magnitude. It is assumed the shearing strain rate at ultrahigh machining speeds should be greater. The difference between the shear strain rate of impact tests and that of metal-cutting leads to consideration of some of the phenomena associated with ballistics and penetration of solids. These phenomena involve compressive stresses, shearing stresses and high velocities, such as occur with ultrahigh-speed machining.

To date it has not been possible to completely describe metal reaction to varying stresses and strain rates. A simplified classification of phenomena could be: elastic, plastic, brittle with frac-

Fig. 5. Tool bit and machined slug used in ultrahigh-speed machining tests. Slug is fired past cutting tool, using a special rifle.

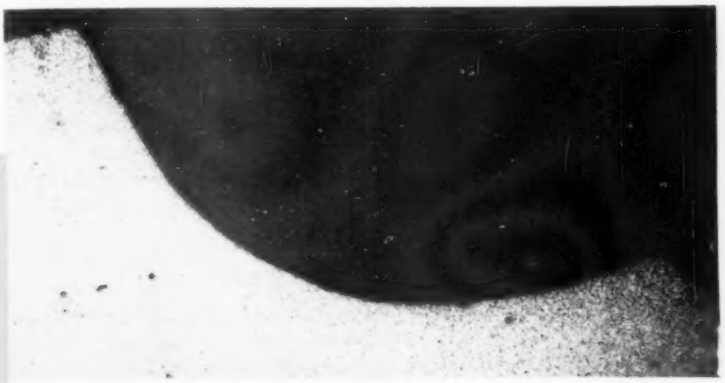


ture, and hydrodynamic. These phenomena are listed in order of increasing strain rates on the material. The theory of dislocations and terminal velocity of dislocations enters here. Dislocations are thought to be responsible for the plastic flow of materials. Authorities seem to agree that, as the velocity approaches the speed of sound in the material, the mass or energy of dislocations becomes infinite. At extremely high stresses and strain rates, metals behave as though their rigidity were zero; i.e., hydrodynamically. The transition points for elastic, plastic or hydrodynamic metal behavior have not been thoroughly studied, although such studies are technically feasible. The condition of "penetration" during machining could be achieved by removing metal faster.

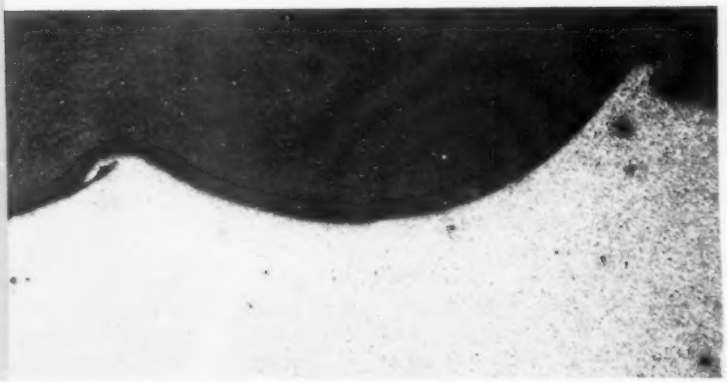
At relatively high machining velocities, brittle fracture could occur, along with large reductions of tool forces and total energy requirements as compared to current machining practices. Materials could then be machined in the fully heat-treated condition with the elimination of extra machining operations and post heat-treat straightening. Machined surfaces would be smoother and more uniform. Tighter tolerances could be held. Phenomena observed from penetration research indicate that at ultrahigh machining velocities aluminum cutters might cut better than steel cutters—an interesting possibility.

Explosive Machining: Lockheed has started testing these theories with an explosive-actuated metal-removal apparatus. It consists of a standard 30-06 caliber Mauser action, a 28-inch-long smooth-bore barrel, a gun stock, and a toolholder screwed onto the end of the barrel to retain a $\frac{3}{8}$-inch square tool bit. This apparatus was designed to propel a 267-grain slug (workpiece) at velocities up to 180,000 fpm across the fixed tool bit. A gage permits setting 0.005-inch increments in depth of cut. To obtain a range of velocities, a standard 30-06 cartridge case using special hand loads of powders is employed. Velocities of 15,000 to 180,000 fpm can be attained. Velocities are verified by a chronograph.

Slugs machined in initial tests were AISI 4340 steel, two inches in length, ranging in hardness from fully annealed to maximum tensile strengths of 280,000 psi. Test firings included the use of both 90-degree V-tools with positive to negative rakes and also broad-nosed tools designed with negative rakes. A machined slug and cutter are shown in



Section near front end of slug.



Section near tail end of slug.

Fig. 6. Sections normal to machined groove on slug. Machining was done at 120,000 fpm. Hardness of slug is 32 R_C. No metallurgical effects are evident from machining.

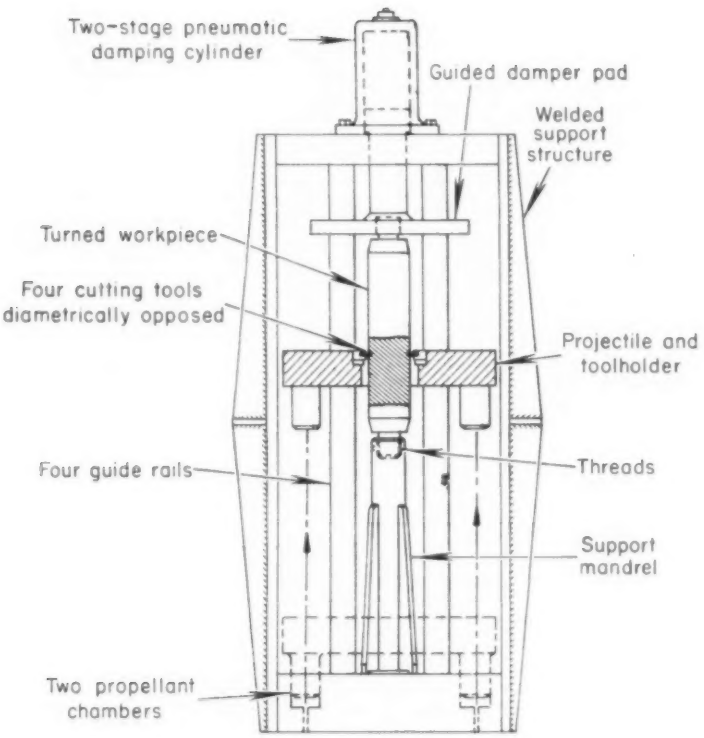


Fig. 7. Tooling for explosive cutting of external splines. Cutting tools are propelled by explosive charge.

Fig. 5. Photomicrographs of sections taken through two of the slugs normal to cutting direction are shown in *Fig.* 6.

In all tests a definite cutting action was observed. No chips were found. Cutters did not fail. Surface finishes were as fine as 15 microinches. An increase in hardness of 1 to 4 points R_C was measured to a depth of 0.004-0.010 inch below the machined surfaces but otherwise no effects on structure were measurable. The hardness of the slug had little effect on the cutting action or final tool condition throughout the test range of velocities. Results of the initial tests established no definite relationship between the tool geometry, tool material, work material or "critical machining velocity."

More elaborate tests are being planned. The tests will be fully instrumented for cutting temperatures, cutting forces, cutting velocities and photographic reproductions of the cutting action. The tests will be based on linear motion with variable velocities starting at current machining speeds and extending to about 360,000 fpm.

Possible Applications: If it is found that hardened steel can be machined at, say 150,000 fpm with unlimited tool life, utilizing this knowledge for production will be an interesting problem. On some types of machining operations, application is only a matter of development. On others, applications may never be practicable. Some ultrahigh-speed machining techniques are already being considered.

The tool could be projected instead of the workpiece, or both the workpiece and tool could move, relative to each other, either lineally, circularly or combinations of both. Perhaps a shaped jet formed by an expanding explosive gas containing abrasive particles will be used for machining. Another basic idea is shown in *Fig.* 7. The part is held in a fixed position and the cutting tools are moved along the part, driven by explosives. A device of this type might be used for generating external splines by indexing the part between shots. Conversely, if a broach, or similar tool, is substituted for the part and the part is affixed to the moving table, an internal spline could be broached.

In any event, the product designer, metallurgist, production engineer, tool engineer and shop operator must work more closely together than ever before to keep designs and methods for producing these designs advancing equally. The development of strong and tough alloys for aerial vehicles is progressing slowly and will not be completed within the next five years. But in the field of metal removal, where great strides have been made in techniques, tools and automatic controls, a still greater effort must be expended in research and development which will bring into being metal-removal rates making those used for aluminum cutting today as outdated as those obtained on the first hand-driven cutting machines.

Gadgets

Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

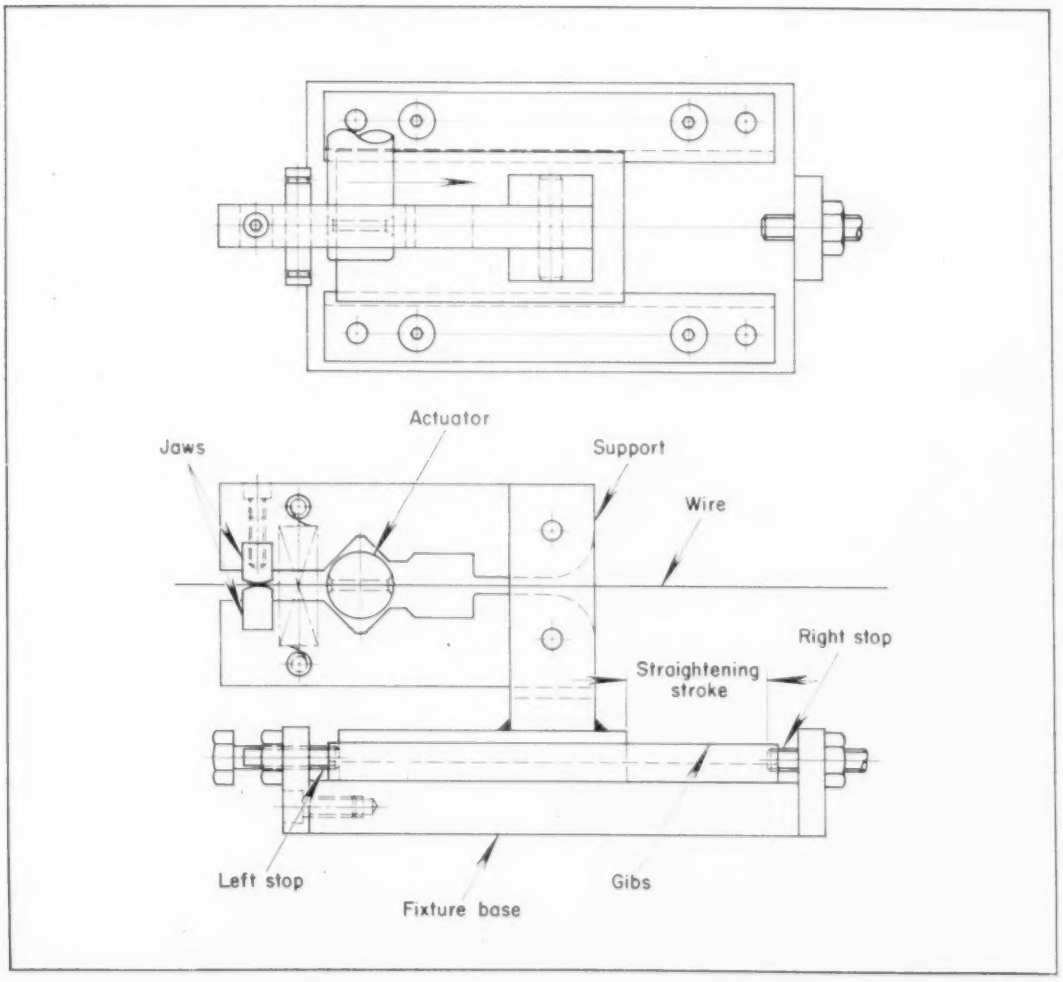
Wire Straightener

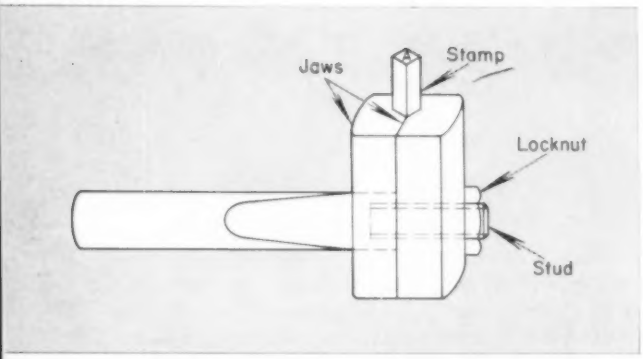
Wire straightening operations can be mechanized with the relatively simple fixture illustrated. This fixture is designed to pull wire off a reel under tension.

Two arms pivot on a support that slides on gibs between end stops. The wire enters the left end of the fixture between hardened jaws mounted in the arms. Gripping pressure is furnished by springs. The arms and support are moved to the right by an actuator powered by a double-acting air cylinder. Straightening continues until the support comes into contact with the right stop. The actuator continues to the right, camming the jaws open.

At the end of the return stroke, the support contacts the left stop and the actuator continues to move until it is located in its original position between the V's. This allows the springs to exert clamping pressure on the wire and the cycle is repeated.

Cliff Bossmann
Dayton Chapter





Steel Stamp Hammer

When using a steel stamp, there is always a possibility of the stamp flying out of the operator's hand as it is struck with a hammer. This potential hazard is eliminated by the special hammer shown. The stamp is securely held between two steel jaws by means of a locknut held on a stud. A piece of lead pipe serves as a hammer handle. Easily constructed, the hammer saves time in stamping operations.

J. Dodd
Detroit Chapter

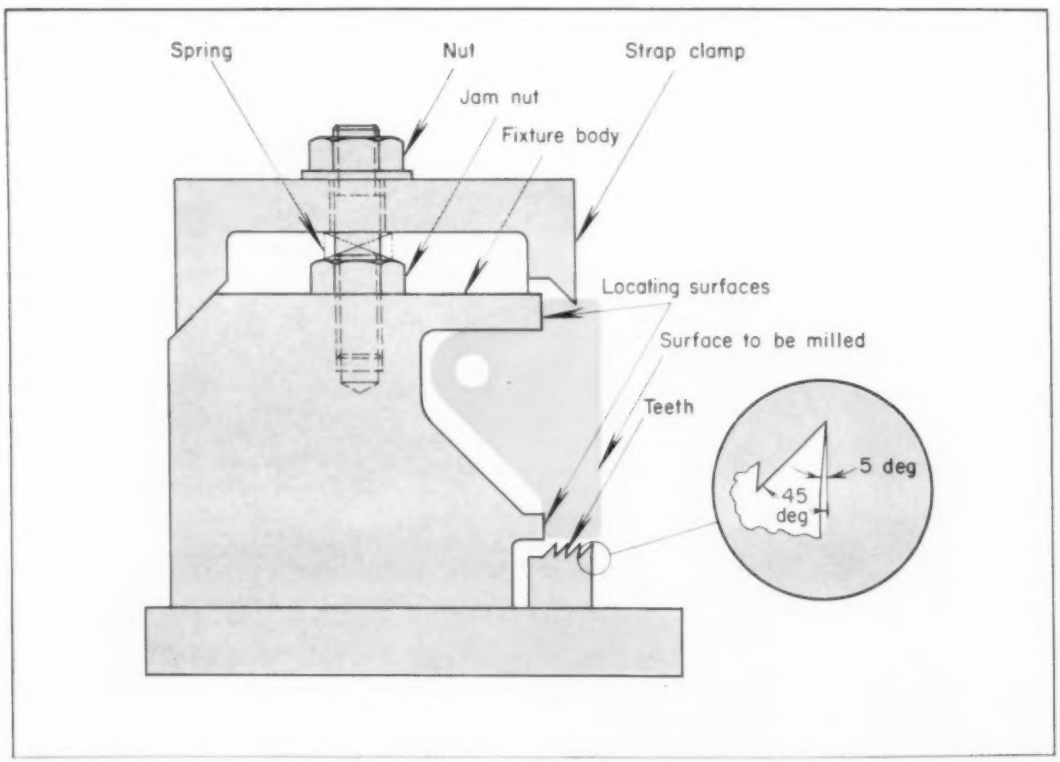
Milling Clamp

Holding large castings for milling operations is sometimes a problem. The milling fixture illustrated is designed to force the workpiece tightly against locating surfaces. A strap clamp fits onto a stud that projects from the fixture body. Since the hole in the strap clamp is oversize, the strap clamp is free to move laterally for a short distance.

When the workpiece is positioned against the locating surfaces and the clamp nut is tightened, cam surfaces on the fixture body and the strap clamp come into contact, pulling the workpiece tightly against the upper locating surface. The bottom of the workpiece is held by teeth on a block fastened to the fixture base.

While this fixture was designed for a specific workpiece, the same principle is applicable to the design of fixtures for holding other large castings.

F. A. Adams
Dayton, Ohio



Thread Tool Setting Gage

Conventional center gages for positioning thread chasing tools have two major disadvantages. It is difficult to hold them in position between the work and the cutting tool with one hand while setting the tool in position with the other hand. Further, conventional center gages provide no means for setting the top face of the chasing tool on the axial plane of the work.

An improved gage, illustrated, corrects both these faults. This gage is supported between centers in the same way in which work is usually held, freeing both hands for setting the tool. The gage is provided with a flat surface, on exact center line, for positioning the face of the tool on the axial plane.

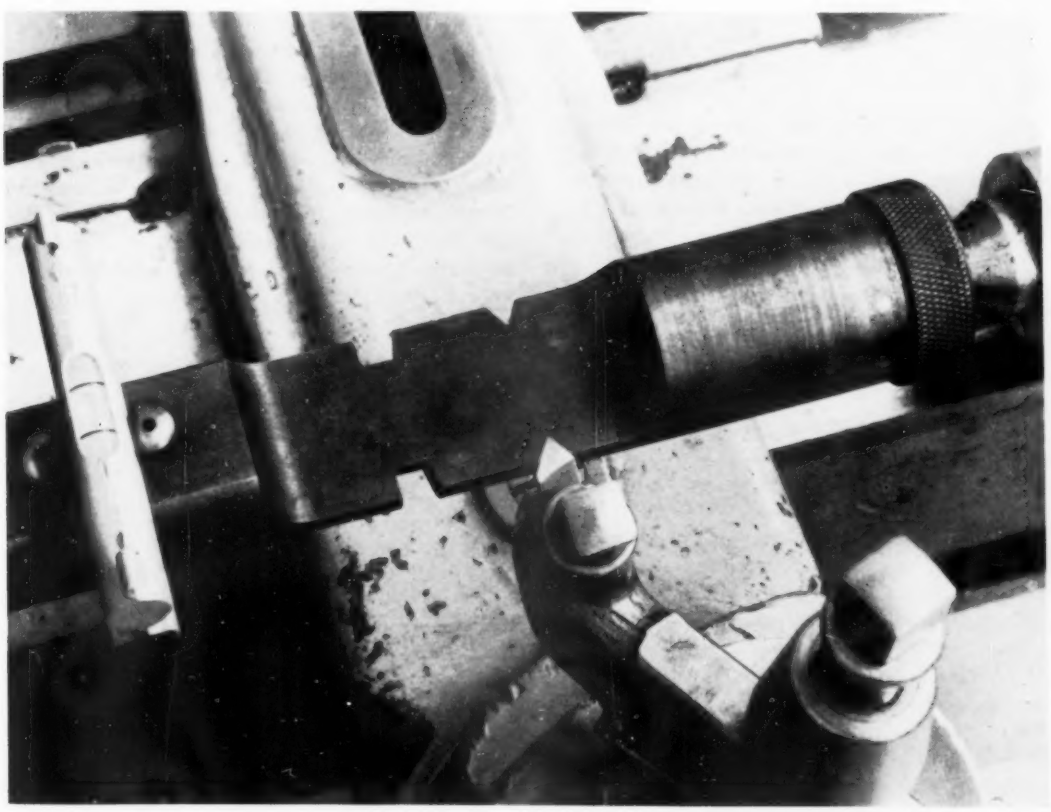
A small level attached to the setting face of the gage permits this surface to be ajusted to an exact horizontal position. In setting, the pointed end of the tool is fitted into a notch in the gage. When the tool face is coincident with the axial plane surface of the gage, the tool is in exact position for chasing an accurate thread form.

The gage is made from 1½-inch diameter mild steel. In making the gage, two accurate annualar grooves are first turned in the stock. A triangular groove with a 60-degree included angle is used for setting tools to the USS thread form. One side of the other groove is turned to a 14½-degree angle for acme thread tools and the opposite side is at a 90-degree angle for square thread tools.

After turning the grooves, stock is milled out to form the flat surface used in setting the tool to correct vertical adjustment. A second milled flat, parallel to the first flat, supports the level. After machining, the gage is case hardened and straightened.

The gage is convenient to use and makes it possible to set threading tools quickly. It can also be used to set the face of any lathe cutting tool to an exact axial plane.

H. J. Gerber
Member-at-Large



YARDSTICK FOR MACHINE

By B. A. Margo
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When to buy new machinery and equipment is a question affecting every industrial concern. The author has developed an objective method for determining the effectiveness of equipment replacement.

MANY COMPANIES are using special procedures for originating requests for replacements. Others go one step further by conducting "post mortem" investigations to find out if anticipated savings were realized. All these endeavors are motivated by the desire to invest the money of the enterprise in the most effective manner. Success or failure in this respect may have a profound effect upon profit-making ability and success of a business. To help management bring this phase of operations under better control, a new yardstick has been developed.

Objective Yardstick Needed: Most replacement studies are based on estimates of future costs. Although parts of such estimates may be based on past experience, it is unavoidable that the subjective opinion of the estimator influences the analysis and determination of such data. His partiality for or against certain machines or processes; his judgment and general outlook; his view of business conditions; his personal interest in the business and his position—all these factors influence replacement decisions. This factor of subjectivity may be reduced to some extent if the estimator is aware of it and makes allowances for it. Another possibility is to split the work of preparing the replacement study between several individuals.

Still, it would help management to have at its disposal an objective yardstick which could be used to check replacement decisions. Such decisions may be too cautious or too optimistic. Either tendency is difficult to detect because an industrial concern can be successful without having an efficient replacement policy. Management should know not only whether an individual replacement turned out according to expectations, but should also know if the best possible results were obtained. Further, management should have a means of detecting how replacements in general fare relative to an objective benchmark. Such data is helpful for control in an individual plant and also for a comparison between several plants.

A New Yardstick: When replacements are justified because of anticipated savings, the company should try to utilize the new asset as long as reasonably possible. For instance, a new machine which saves labor cost and reduces scrap while improving the quality of the product, should be kept in operation until a study shows that it should be replaced. Management must try to maintain a high rate of annual savings for as many years as reason-

Nomenclature

F = Present worth factor
I = Investment (dollars)
i = Rate of return on investment
L = Least number of years to realize one percent less than maximum return
n = Number of years
P = Present worth
R = Annual savings
S = Actual service life
U = Weighted utilization factor

REPLACEMENT

ably possible. These savings are the essential factor; the calculated return on investment is only a measure. The accompanying chart shows that this is, however, an important measure.

As an example, an investment of $10,000 may promise annual savings of $2500, providing a ratio of investment to savings of 4:1. Referring to the chart, after four years the return on investment is zero since the total return equals the investment and no over-all savings have been realized. After four years, however, the annual return on investment increases and is close to 25 percent at 20 years. Eventually, the return will reach a maximum. This maximum provides a good objective yardstick. Unfortunately, the maximum is reached only after an infinite number of years. A return slightly smaller than the maximum can be easily calculated and can be reached in reasonable length of time.

In TABLE 1, ratios of investment to annual savings are listed in the first column. Maximum possible returns for these ratios, which would theoretically be reached at infinity, appear in Column 2. The number of years required to reach returns which are one percent smaller than the maxima in Column 2 are shown in Column 3.

The formula which was used for calculating the amounts in Column 3 is as follows:

$$1.01\left[(1+i)^n-1\right]=(1+i)^n \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where i is rate of return on investment and n is number of years. This formula has been derived from the present worth factor, a concept which has been evolved in studies of engineering economy. The present worth factor F for a uniform annual series of payments, in this case savings, is:

$$F=\frac{(1+i)^n-1}{i(1+i)^n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Multiplying F by annual savings R gives the present worth P of the investment, therefore $FR = P$ or $F = P/R$, which is the investment divided by annual savings. This is the ratio used in the graph. From Formula 2 follows:

$$Fi=\frac{(1+i)^n-1}{(1+i)^n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$=\frac{P}{R}i$$

For $n = \infty$, the right side of Equation 3 becomes 1 and i reaches its maximum for the specific ratio P/R or $i = R/P$. This is the concept of capitalized cost.

A slight distortion of the right side of Formula 3 by the factor 1.01 leads to Formula 1 which may be used for finding the number of years in Column 3 of TABLE 1.

$$\begin{aligned} 1.01\ (1+i)^n - 1.01 &= (1+i)^n \\ 0.01\ (1+i)^n &= 1.01 \\ (1+i)^n &= 101 \\ n\ log\ (1+i) &= log\ 101 \\ n &= \frac{log\ 101}{log\ (1+i)} \end{aligned}$$

Application: Using the numbers in Column 3 of TABLE 1, a new kind of utilization factor can be computed. An example of how this factor is computed is shown in TABLE 2.

Where S is actual service life, L is least number

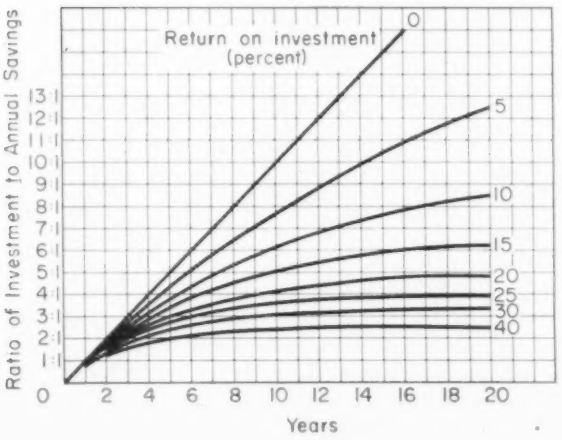

Table 1—Return on Investment

Ratio of Investment to Annual Savings	Maximum Theoretical Annual Return (percent of investment)	Years Required for Return One Percent Lower than Maximum
2.5:1	40	14
3.3:1	30	18
4.0:1	25	21
5.0:1	20	25
6.6:1	15	33
10.0:1	10	49
20.0:1	5	95

of years and I is investment (dollars), weighted utilization factors U are calculated as follows:

$$U = \frac{S}{L}\left(\frac{I}{100{,}000}\right)$$

Weighing in this manner is advisable since an item with low value and poor utilization such as Item No. 3 would otherwise distort the average weighted utilization factor.

Preparation of the table is split into two operations. At the time of acquisition of a new asset, the date of entry and the next three columns is filled out. Service life is the number of years during which the asset will serve its original purpose and is assumed to produce the equal annual savings. Any additional use for another purpose at a later date may produce additional savings; however, this possibility is excluded. The data in the columns "Investment" and "Estimated Annual Savings" are used to calculate the ratio. Then the time allowed for return may be taken from Column 3, TABLE 1.

At the end of the service life, the rest of the data is entered in TABLE 2, and the average weighted utilization factor is adjusted.

An analysis of TABLE 2 shows that if the utilization of each individual item was for a shorter or longer period than expected and how much less than the least number of years allowed. Further, it indicates whether the individual utilization factor was relatively high or low. In addition, the table shows up any tendency of general improvements or deterioration, if the average utilization factor moves in one or the other direction.

Knowledge of the least number of years should be helpful. Nobody is expected to keep a machine or other asset in operation for the original purpose for a period longer than indicated by replacement studies simply because the least number of years has not yet been reached. If equipment has to be disposed of before the end of the anticipated useful period, means of prolonging this service life should be investigated. Perhaps it is worthwhile to improve maintenance methods or to install a setup of limits of tolerable maintenance cost per machine.

TABLES 1 and 2 are based on the assumption of equal annual savings during the anticipated service life of an asset. Actually, savings may fluctuate continuously and may drop more than expected. (A drop of savings should be considered in the work sheet of the replacement study.) In the latter case, it would take more than the least number of years to reach the best possible return or the percentage figure in question, which is one percent smaller.

Table 2—Replacement Data Record

Item	Entry Date	Investment (dollars)	Estimated Annual Savings (dollars per year)	Estimated Service Life (years)	Entry Date	Actual Service Life (years)	Time Allowed for Return (years—from Table 1)	Weighted Utilization Factor
1	Nov. '56	75,000	30,000	7	Oct. '61	5	14	0.268
2	Jan. '58	300,000	45,000	12	Feb. '73	15	33	1.362
3	Jan. '58	12,000	3,000	9	Dec. '60	3	21	0.017
4	Feb. '58	50,000	10,000	8	Apr. '73	15	25	0.300
Average		109,250	22,000					0.486

This possibility is part and parcel of operating a business and should not be a sufficient reason to discard the idea of the yardstick. In other words, if discrepancies between estimates and actual results happen too often, it would be worthwhile to investigate the reasons and to consider whatever can be done to improve the situation.

TABLE 2 contains essential information in a brief form so that executives may find facts quickly. A short explanation of the individual items or department numbers can be added. In any case, TABLE 2 should never be used as an accumulation of dry statistics. Its purpose is to furnish management with an additional means of control.

"Not an instant is wasted getting his stuff into production."

NUMERICAL CONTROL for the SMALL SHOP

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Tape-controlled automatic positioning systems are simple to program and easy to operate. The authors describe one such system and show how it has been applied to reduce costs on typical parts.

SINCE THE ADVENT of the USAF machine tool procurement program, there have been many applications of numerical control in the aircraft industry. This pioneering work has demonstrated that substantial production gains can be made through numerical control. Lead time is reduced, accuracy is improved and machine productivity is increased.

Most of the controls developed for the aircraft industry are for complex contouring machines and elaborate computational equipment is required to develop machining programs. Such equipment is costly. Training and maintaining a staff of technicians to use the equipment is an added expense. Accordingly, managements of smaller plants have hesitated to utilize numerical control systems.

Today, however, a number of relatively simple systems are available for typical small shop applications. The Digimatic system, for instance, can be programmed by an engineer after only a few minutes of training. This two-dimensional system can be used with any machine that requires precise positioning of the work, such as a drill press, spot-welder, riveter or component inserting machine. As applied for drilling operations, the system consists of a tape preparation unit, a control unit and an automatic positioning table mounted on a multiple-spindle turret drill, *Fig.* 1.

Operating the punched-tape preparation unit, *Fig.* 2, is similar to operating an adding machine. Numerical position commands are entered into the center block of keys. The three white keys at the left command *X*-axis motion, *Y*-axis motion or no table movement. Dark keys at the left of the keyboard command auxiliary functions such as select-

Fig. 1. Equipment for numerically controlled drilling operations. Working from blueprint, tool engineer codes machine instructions on tape-preparation unit at left. Tape is inserted in control unit (center) that operates turret drill press.

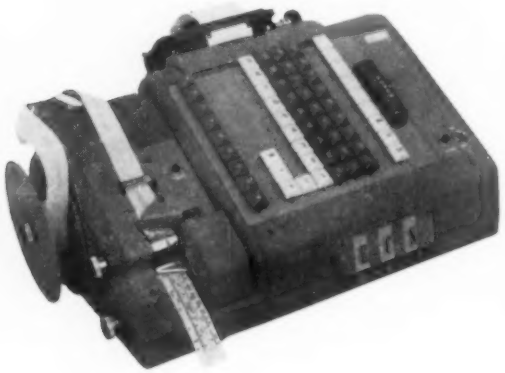

Fig. 2. Punched tape preparation unit prepares control tape for machining operations. Numerical information is simultaneously printed on paper tape for verification.

ing spindles or operating coolant pumps. White keys at the far right command machine operations (such as spindle plunge) after the table has reached its position.

To program a point, the auxiliary function is commanded, the axis of motion selected, the position coordinate entered directly in inches and decimal fractions and the machine operation commanded. Then the punch bar is depressed, causing the full keyboard entry to be punched on a one-inch-wide standard control tape. Simultaneously, the entry is printed on paper tape for verification. Should an

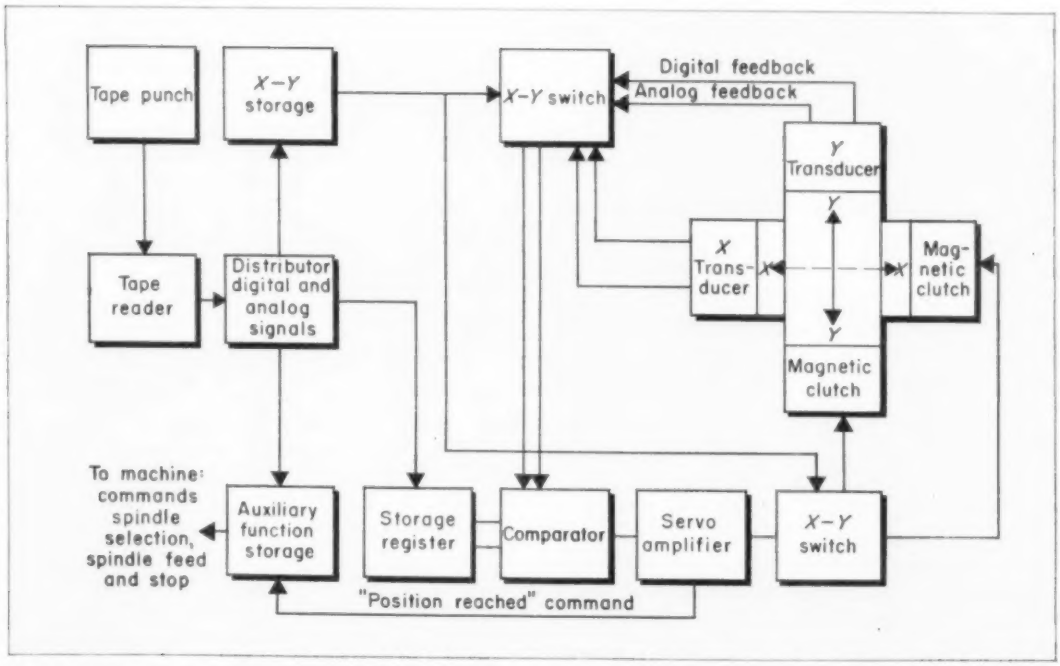

Fig. 3. Information flow block diagram. Feedback signals from machine table are matched with input signals to make sure table is in position commanded by tape. This "double check" insures accuracy.

error be noted, the button on the top of the tape punch is pressed. This causes the tape reader in the machine to skip the block of incorrect data.

Entries for each position are accomplished in the same manner until the program is complete. The printed tape can be stored as a record of the program.

One of the major design goals of the point positioning system was that it should be easy to operate. In several cases, machinists have learned to use the system after only five minutes of instruction. Controls for the system are located on the control unit just above the tape reader. The controls consist of power on-off buttons, a start button, and *X* and *Y* jog controls. The blank workpiece is clamped to the table at a reference location where the table coordinates coincide with the drawing coordinates. All that is required to operate the system is to insert a punched tape in the reader, turn on the power and press the start button. When the workpiece is complete, the program stop light comes on. At this time the tape can be rerun or a new tape inserted for another part design. For repetitive work, the ends of the tape can be cemented together to form an endless loop, eliminating tape rewinding.

The job controls are used to move the table to approximate locations for ease in setup. In attaching the work to the table, only a clamping or holding fixture is required. Because of the accuracy of the positioning system (within 0.001 inch) drill jigs are unnecessary.

A block diagram of the system, indicating the information flow, is shown in *Fig.* 3. When tape is inserted in the reader on the machine, information is distributed to the *X-Y* storage, the auxiliary function storage and the storage register.

The *X-Y* storage controls a switch that connects the control unit to either the *X*-axis or *Y*-axis of the table. Information such as spindle selection commands, feed rates and drill commands is stored in the auxiliary function storage. Numerical position commands are stored in the numerical position storage.

Each axis of the table contains a transducer. The transducer generates an output signal that represents the table location to the nearest 0.001 inch. Signals from the storage register and from the transducer are compared in the comparator. The sign of the voltage signal from the comparator indicates the direction of the error; i.e., whether the number out of the transducer is larger or smaller than the number in the storage register. When a number in the transducer is equal to a number in the storage register, the comparator output is zero. This condition occurs when the table has reached the commanded position.

The *X-Y* switch connects the servo amplifier output to either the *X* or *Y* axis magnetic clutches. When energized, the clutches apply rotational power to the table leadscrew, thereby causing the table to move. In brief, the system operates by reading a position command from the tape, storing the command in the storage register, comparing

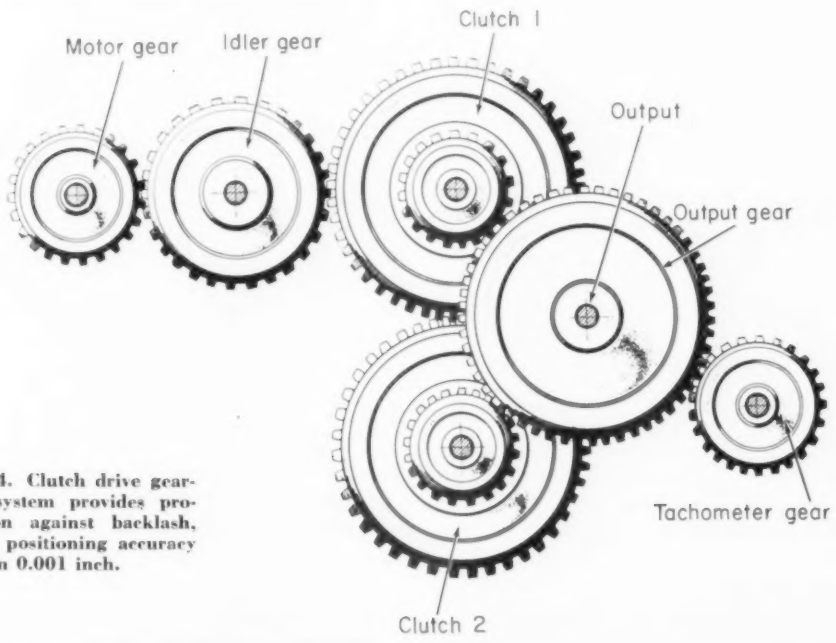

Fig. 4. Clutch drive gearing system provides protection against backlash, gives positioning accuracy within 0.001 inch.

the present table position with the commanded position and moving the table until it is at the commanded position.

Table travel is 14 inches in one axis and 18 inches in the other. Minimum-weight design, ball-bearing ways and leadscrews facilitate the performance of the servo system. Motors, clutches and transducers are mounted inside of the table castings for protection. Magnetic brakes hold the table in position during the machining operation.

Backlash is prevented by the clutch drive gearing system shown in *Fig.* 4. The bodies of the clutches are rotated constantly by the motor through the motor gear, the idler gear and the clutch peripheral gears. Clutch number 1 rotates in the opposite direction from clutch 2. The gears shown in the center of the clutches rotate in the same direction as the clutch body when the clutch is energized. Center gears of the clutches drive one large output gear that is connected directly to the leadscrew of the table.

When clutch number 1 is energized, the leadscrew rotates in the opposite direction. Each clutch is always slightly energized, providing an opposing torque to the output gear. To cause table motion, one clutch is energized more than the other, thereby providing a preload on the output gear that prevents backlash even though the gears may become worn.

Cost savings with the automatic point positioning system have been substantial. Not only is the actual work performed in less time and more accurately, but initial planning, setup time and fixtures costs are greatly reduced. As an example, the direct labor and overhead cost of manually drilling 100 of the parts shown in *Fig.* 5 was $125. The cost of drilling 100 of the same parts with numerical control was $50. Total fabrication cost, including drill jigs and layout was $475 for 100 manually produced parts, as compared to $70 for 100 parts produced with numerical control.

In general, machining with this numerical control system is from two to nine times faster than with manual control. The work is moved at a rate of 100 inches per minute and is relocated with an accuracy within 0.0002 inch. Tape reading time is 0.4 second; therefore parts are moved from one point to another in about 1½ seconds.

While cumulative savings are greatest when a number of parts are to be run, savings are possible with "runs" of only one part. This is illustrated by drilling of a single part for an electronic assembly. The part consisted of a long narrow strip of metal with two rows of 50 holes each, to be spaced on ½-inch centers to an accuracy of 0.01 inch.

The machine shop estimate of the time required to drill these holes by conventional methods was 1½ hours: 1 hour for layout and ½ hour for drilling. With numerical control, the holes are drilled in 10 minutes within an accuracy of 0.001 inch. The punched tape is stored for use in the future whenever additional parts are to be made.

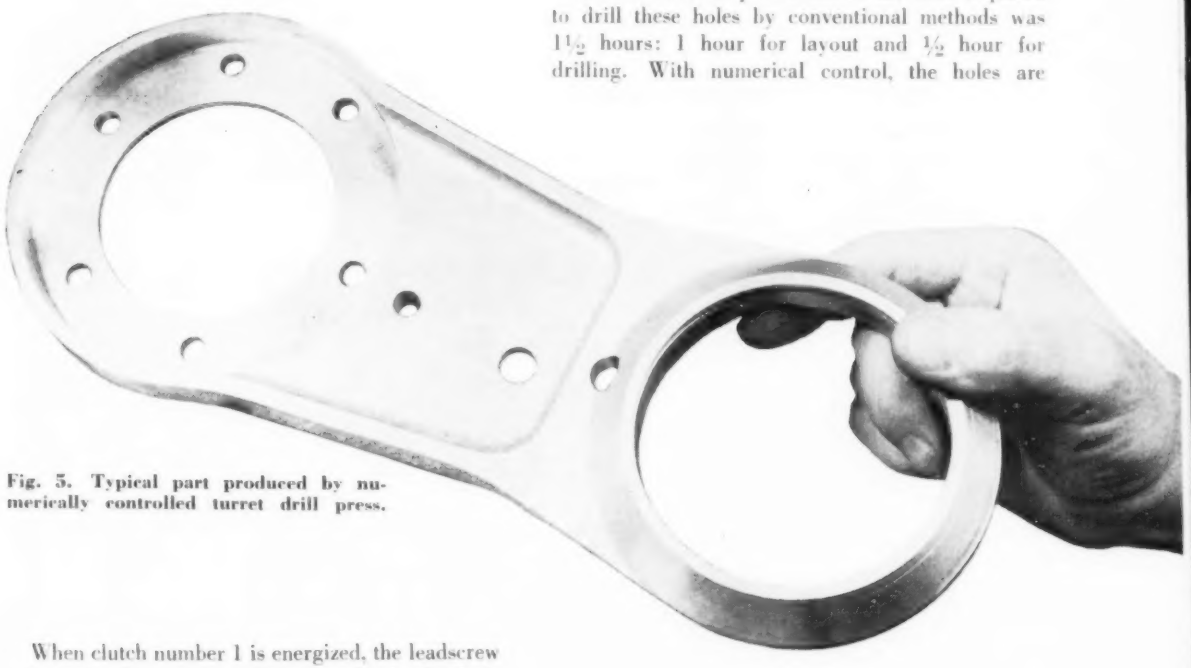

Fig. 5. Typical part produced by numerically controlled turret drill press.

Speed and versatility—the two major advantages of numerically controlled positioning systems—have been amply demonstrated in many small plants. From 50 to 60 percent of all production in the metalworking industry is on a job-lot basis. It is in such work that numerical control will bring greatest benefits to industry.

microhardness testing

• equipment
• techniques
• applications

By Vincent E. Lysaght
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Microhardness testing techniques provide accurate quality control for applications where conventional hardness testing equipment cannot be used. This article describes microhardness testing techniques and procedures and suggests many areas of possible application.

CHECKING HARDNESS of small parts or thin materials is often difficult or impossible with conventional hardness testing equipment. Microhardness testing provides a measuring method for use on materials where Brinell or Rockwell equipment will not produce accurate results, or checking causes destruction of the sample. Microhardness testing, *Fig.* 1, is accomplished with small indentations and light loads and includes hardness ranges normally checked with ordinary equipment.

Areas of Application: Although not a high-production technique, microhardness testing serves well as a method for checking the hardness of thin materials, plated coatings, small diameter wire and small precision parts. It is also used to determine hardness gradients in superficially hardened surfaces, for exploring hardness variations over small areas and for determining the hardness of different alloy constituents.

Types: Microhardness testers fall into two general groups: those based on the scratch method and those operating on the indentation principle. The indentation method is preferred because of difficulties experienced in scratch testing, such as accurately determining width of microcut, minimizing formation of burrs caused by the diamond indenter pushing material out and above the surface of the test specimen, and trouble involved in care of the diamond point. Some testers have an indenter mounted in the front lens of an objective in a microscope. Others provide for the specimen to be attached to a counterbalance beam. They are either weight loaded or spring loaded and utilize various methods of applying and calibrating a load.

Fig. 1 illustrates a type of microhardness tester

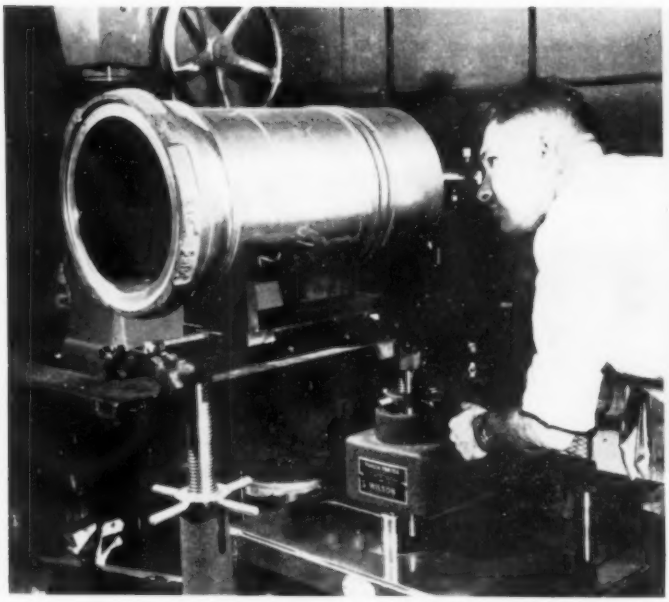

Fig. 1. Microhardness tester being used to determine hardness of chromium plating on inside of large cylinder.

which is now in general use. This unit, which can also be used for heavy-load microtesting, applies loads from 10 to 50,000 grams. The 10-gram load is included for comparative testing only. It may be used with either a Knoop or 136-degree diamond pyramid indenter.

The 136-degree diamond indenter is a diamond in the form of a square-base pyramid having an included angle of 136 degrees between faces, with a tolerance of ±1 percent. This indenter thus has an angle across corners, or edge angle, of 148 degrees 6 minutes 42.5 seconds. The facets are highly polished and free from surface imperfections. The point is sharp. The 136-degree diamond pyramid number, often designated as DPH, is the quotient of the applied load divided by the pyramidal or surface area of the impression.

The Knoop indenter, *Fig.* 2, is a sensitive indenting tool, which gives indentations of accurately measurable length in even the most resilient steel with loads of less than 1000 grams. It is made of diamond and is ground to a pyramidal form that produces an indentation having long and short diagonals of approximate 7 to 1 ratio. The pyramid shape employed has included longitudinal angles of 172 degrees 30 minutes and an included transverse angle of 130 degrees zero minutes. The depth of indentation is about one-thirtieth of the length.

Procedure: The tester is fully automatic, operating under electrical control in a synchronous cycle. The operator selects the correct position for test under high magnification, locates the selected area under the indenter, then brings the specimen back underneath the microscope for reading *Fig.* 3. The correct hardness number is calculated from the diagonal length. For making indentations in selected small areas, a mechanical stage is provided. Thus, an area of a few thousandths of a square millimeter can be accurately located under the microscope.

The rate of application of the indenting load, the length of time for applying the load, and eventual removal of the load are automatic. The load is applied for a duration of about 15 seconds. Deadweight loads of 25 to 3600 grams are available. These relatively light loads are applied in such a manner as to eliminate errors due to inertia. A mechanically operated tester is available for applying loads of from 1 to 3000 grams.

Most static indentation testing is performed with a load of under 1000 grams. Either a 136-degree square-base diamond pyramid or an elongated Knoop diamond indenter can be used. The load must be applied without friction or impact if reliable results are to be obtained. It is important that the surface being tested be lapped plane and be free of scratches. For tests with loads of 100 grams or lighter, a metallographic finish is necessary.

Hardness of Electrodeposited Metals

Metal	Knoop Hardness at 100-Gram Load
Cadmium	37
Silver	60
Zinc	120
Copper	165
Nickel	550
Chromium	935

Plated Coatings: Correctly determining the microhardness of the interior surfaces of chrome-plated metal castings is a particularly difficult and vexing problem when conventional methods are used. Microhardness testing, however, solves the problem.

The tester used is mechanically operated and the load applied under dashpot control. The speed of load application can be varied from less than 0.04 inches per minute to as fast as testing permits accurate results. The rate of application and duration of applied load are under control and direction of the operator. Leads from 1 to 1000 grams can be applied to any specimen under observation. Focusing the impression under the microscope is accomplished by moving an elevating mechanism.

It has been determined that the basis metal has negligible effect on the hardness of the plate, provided that the plate is approximately 0.0005 inches thick or better. Hardness tests of plated surfaces have been made on electro-deposits of cadmium, silver, zinc, copper, nickel, and chromium and are indicated in the accompanying table. These values should not be considered as representative of the plated surfaces under all conditions. Such factors as current density, temperature and composition of plating solution, variation in hardness from the outside to inside of the plate and structure of the electrodeposited metal, all influence the hardness determination.

Thin Materials: For the accurate determination of hardness values with conventional testers such as Brinell, Rockwell or Rockwell superficial, the piece being tested should be thick enough to prevent any bulge or other markings from appearing on the surface opposite the indentation. Generally, the thickness of the specimen should be at least 10 times the depth of the impression. When testing hardened steel with the Rockwell superficial tester, using the lightest load of 15 kilograms, the depth of indentation is about 0.0005 inch; so, a specimen thickness of at least 0.005 inch is necessary.

A microhardness testing instrument is used by a large control manufacturer for controlling the hardness of bimetal strip. The bimetal unit is made up of two layers which, by virtue of differences in the coefficient of expansion, deflect when subjected to changes in temperatures. The largest percentage of material used in the bimetal strips is nickel steel and chromium-plated steel. Alloys such as brass, stainless steel, chrome iron, silicon bronze and others, are also combined into thermostat metals. The metals are bonded together in 1⅝ to 2¼-inch-thick slugs and are rolled into thin strips to a minimum over-all thickness of 0.003 inch. Essentially, the hardness test in this instance serves as an indication of the forming qualities and the yield point. It is also a final check of the annealing and reduction processing cycle.

The 136-degree diamond pyramid indenter is used and the load is varied according to the thickness of the metal under test. Laboratory testing previously determined the correct load for testing an individual layer of metallic strip without having the results effected by the other metal. Small samples are cut from the strip and are supported in a sheet metal clamp. The width varies from a minimum of 0.040 inch to a maximum of four inches. The difference in hardness on each side of the metallic thermostat may be as much as 100 DPH numbers.

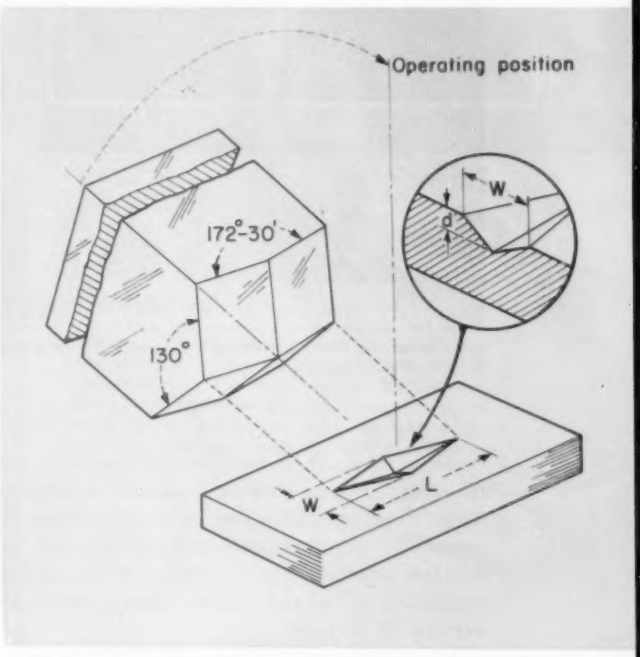

Fig. 2. Diagram of Knoop diamond indenter used for microhardness testing. The diagonal lengths of the impression are in the ratio of seven to one. Depth of the impression is approximately one-thirtieth of the length *L*.

The microhardness tester is housed in a telephone-booth type structure in the inspection department. A total of seven qualified inspectors utilize the instrument. The engineering department of the organization also has access to the tester and several hundred tests are made each week.

Limitations: Perhaps the most serious limitation of microhardness testing is the necessity of properly prepared samples. They must be lapped flat and be free of scratches, and be mounted or supported so that the indenter is normal to the

Fig. 3. Selection of the exact point of testing is done by means of a microscope. After the impression is made, the microscope is used for reading length of the impression.

testing surface. These requirements mean that considerable time must be spent in sample preparation. Often metallographic polishing methods must be employed. Accurate tests cannot be made on rounded corners. Great care must be exercised in preparation of samples in order to minimize cold-working the surfaces.

Loads lighter than 25 grams must be used with great care. The accuracy of indentation measurements is about one micron, i.e., ±0.5 micron. On hard steel, using a load of 25 grams and a Knoop indenter, the length of indentation is about 20 microns. A difference in the determination of one micron, therefore, represents a 5 percent difference in measurement, or about 10 percent difference in Knoop number. With the 136 degree diamond pyramid indenter, the length of indentation under 25 grams is seven microns. Thus, a difference in length of one micron results in a 15 percent difference in measurement. This is a difference of from 825 to 1100 DPH numbers. For qualitative work, tests made with lighter loads may be of value.

Tests made with loads under 25 grams (and possibly from 25 to 100 to a lesser extent) are subject to the several possible sources of error. The first is the influence of surface preparation on surface hardness. When the depth of indentation is only one to two microns it is almost impossible to prepare the sufrace without seriously affecting the outer first micron of depth.

Friction during penetration of the indenter becomes important when extremely light loads are applied. The rate of load application greatly affects readings. Results are usable only when these factors are controlled, and comparisions of microhardness results with light loads will vary with method and rate of load application.

Another variable with extremely light loads is the effect of "sinking" and "ridging" of the impression when using the 136-degree diamond pyramid indenter (under 25 grams). With light loads it is practically impossible to determine the length of the diagonal, and a small error due to the fact, that the surface is disturbed even at the corners of the diagonals introduces serious errors in the result.

The microhardness test provides a quick and inexpensive means of quality control when hardness is related to quality. This quality control method, when properly used and interpreted, can materially reduce inspection costs.

Treated Shafting Promises New Uses

HARDENING, grinding and straightening operations on purchased steel bars may be avoided because of a specially treated shafting. The ready-to-use bars, ground and hardened to 60 R_C, are created by a combination of carbon correction plus continuous induction heat treating, grinding and straightening.

Basis for production of the shafting is the carbon correction process developed by the Union Drawn Steel Div. of Republic Steel Corp. The shafting material originates in the form of carbon steel bars. Through carbon correction annealing the carbon lost by decarburization during hot rolling is restored to the surface of the bars, and this permits induction hardening by Thomson Industries, Inc., which is supplying the new material under the name "60 Case." Grade of steel specified contains 0.60 percent of carbon allowing the induced surface hardness of 60 R_C. This has a tensile strength of approximately 335,000 psi which is about three times the tensile strength of unhardened steel. The tensile strength of a 60 Case shaft is a function of the ratio of the case depth to the diameter. In smaller sizes the tensile strength is improved about 100 percent.

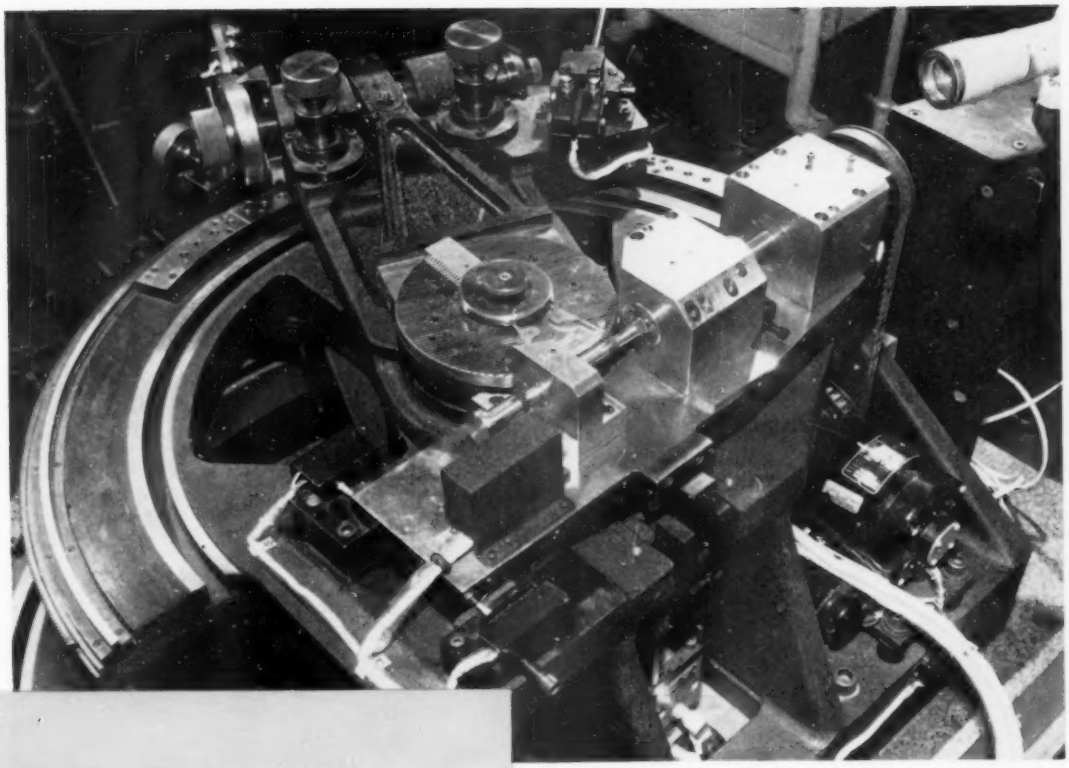

Fig. 1. Sector gear generating machine for manufacturing missile guidance system components. The gear sector blanks are positioned optically on the manually operated index table, the table is locked in position and one tooth is cut per index.

tooling the SNARK

By A. S. Turner
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Advances in missile guidance technology have fostered the development of new manufacturing techniques to produce components to exacting tolerances. The author shows how creative tool engineering has solved unusual production problems on these components.

Abstracted from Paper 157, "Tooling the Snark Is an Inside Job," presented at the 26th ASTE Semi-annual Meeting. Copies of the complete paper may be purchased from Society Headquarters.

FABRICATION OF THE AIRFRAME for a winged long-range missile like the Snark presents no difficult problems to tool engineers experienced in airframe work. Manufacture of precision components for the guidance system, however, calls for entirely new concepts and techniques. The requirement for functional reliability imposes that tolerances be held within closer limits than is possible with conventional machining and inspection methods.

Gear Sectors: Gear sectors are an example of the close-tolerance components in the Snark guidance system. Sectors, when mated with their respective worms, translate motion for angular positioning. Specifications of the gear teeth on the

Fig. 3. (right) Special high-speed boring machine for angular machining an aluminum casting within plus or minus 30 seconds angular limits. The fixture is mounted on a standard index table and the part is accurately positioned under the boring head for machining.

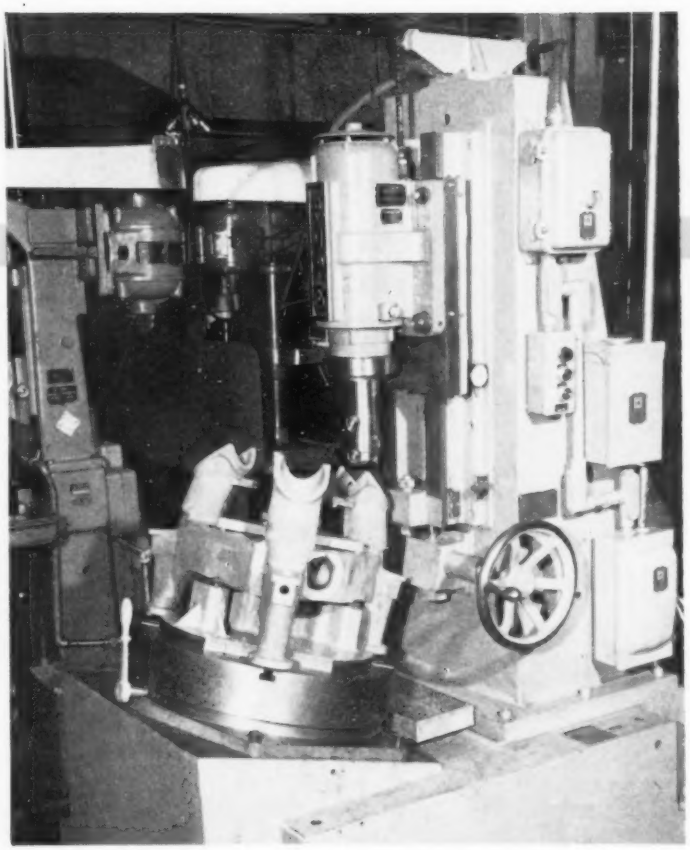
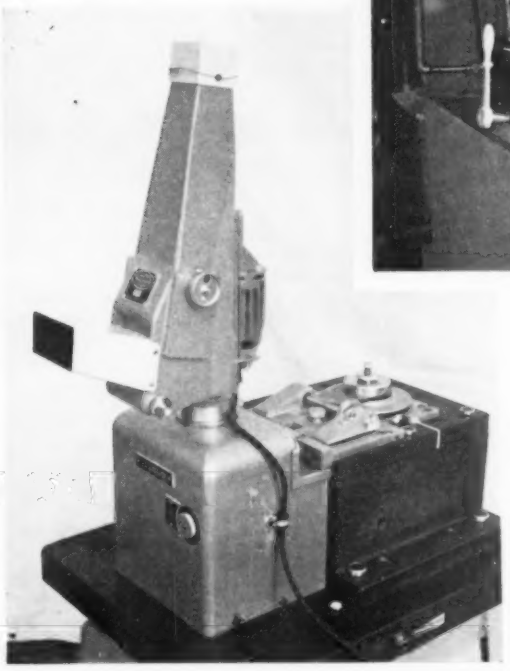


Fig. 2. (below) Optical checking fixture for determining the angular position of sector teeth relative to its mounting shaft center line. Mirrored-surface type reflector units are mounted below the checking stage for the sector on the spindle assembly. Rotation of the sector one gear tooth also rotates the reflector. The deviation from the desired angular relationship can be checked with one-half degree.



sector call for a tolerance of 5.0 seconds of arc from tooth to tooth, noncumulative over 54 teeth. No conventional gearcutting machines can consistently produce sectors to such close tolerances. No equipment suitable for checking to this degree of accuracy is available. Consequently, the job of developing such equipment fell upon the tool engineers at the start of the Snark program. Since the noncumulative tolerance precluded use of the customary continuous hobbing or mechanical indexing principle of gear cutting, it was decided to resort to an optically measured, manual-indexing method.

Fig. 1. Instead of moving the gear sector in geared relationship with the hob, the gear sector is optically positioned and firmly fixed during the generation of each full tooth. Generation of the teeth is accomplished by a leadscrew which moves the hob tangentially to the gear sector pitch diameter. Upon completion to tooth depth, the gear sector is repositioned angularly by optical means for the next series of passes. The operation is repeated until all teeth are completed. Primary and secondary optical systems employed for the positioning have permitted accuracies to one-tenth of a second of arc.

Optical principles were also used in the design of checking equipment. A check fixture, utilizing mirrored-surface type optical reflecting units, was developed, *Fig.* 2. The reflectors are mounted in an established relationship with a spindle assembly to which the gear sector is attached. By rotating the gear an amount exactly equal to the angular spacing of one gear tooth, the reflector is also rotated the same angular amount. Using an integrally mounted angle Dekkor type autocollimator, any deviation in the required angular measurement can be checked to the nearest one-half second.

The gear sector is located by a taper and clamped

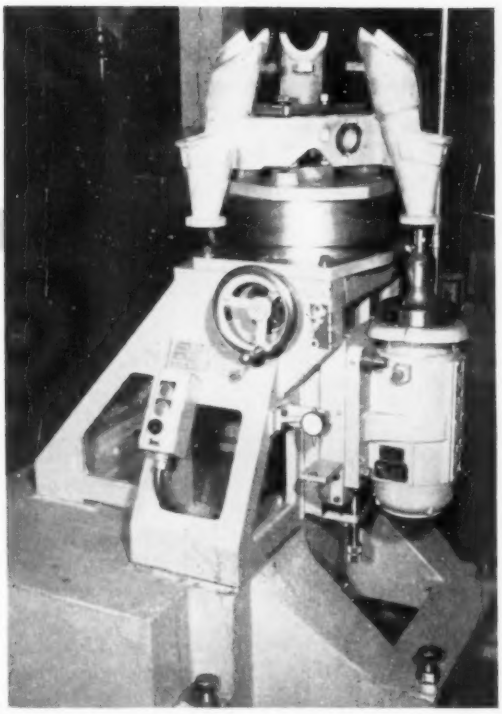


Fig. 4. Boring operations on the same casting machined on the special boring machine shown in *Fig.* 3 are completed on this special unit. Both operations are performed relative to the same locating face and angular position is obtained by optical dividing heads.

to the top of the spindle assembly. By means of a worm gear the clamped sector can be located an amount equal to that of a single tooth spacing. Precise single tooth spacing rotation is controlled by an indexing wheel on the end of the worm which provides positive indexing. A disk type brake, mounted on the spindle, locks the spindle while readings are taken. The reading screen scales are calibrated in seconds and by micrometer adjustment of the bifilars to original position, errors can be read on the micrometer to the nearest one-half second on the workpiece dimensions.

Stainless Steel Plate: Another close-tolerance part was a 17-7 PH stainless steel plate. This part, used as a master reference surface, has ½ fringe flatness specified in the center reference area. Grinding and lapping operations are used to generate the required flatness. Inspection is accomplished by measuring the reflectivity of the surface. A minimum reflection of 10 percent of introduced tungsten light, filtered through a No. 57 Wratten filter and measured 15 ± 5 degrees from normal to the reference plane, is required for acceptance.

Angular Milling and Boring: An intricate sand casting of 356-T61 aluminum is another example of a component with close accuracy requirements. Difficult milling and boring operations must be performed to accuracies within plus or minus 30 seconds (angular limits). One-eighth inch of stock is removed during machining. The casting is first rough machined to remove 0.045 inch, after which it is solution heat treated and aged. Semifinish machine removes another 0.060 inch of stock and is followed by a similar heat treatment and aging. Finish machining removes the final 0.020 inch.

Special high-speed milling and boring machines, *Figs.* 3 and 4, were designed to achieve the required accuracy. Angular indexing to preset stations is made through optical dividing heads.

One of the difficulties experienced in building these units resulted from induced stresses in the machine structures. Only through the use of analytically placed strain gages was it possible to determine the magnitude and location of these stresses to take the necessary corrective action.

Tooling challenges revealed by the Snark and its contemporaries indicate future trends. It is inevitable that the more precise methods and techniques of manufacturing and quality control, which are now employed primarily in the laboratory, will be introduced in production lines.

Compounded Economy from Forging Development

SAVINGS in material, weight and cost of finished forged parts are promised by a rotary forging process developed by Curtiss-Wright Corp. The technique utilizes four die faced hammers to forge a vertical, rotating billet of steel or other premium alloy into a final shape. It works hot or cold, using round, square, solid or hollow billets.

Speed appears to be a prime advantage of the method: in one example of operation, a piece having seven outside diameters plus four inside diameters is forged in 40 seconds with appreciable savings in material. Splining or internal gearing is formed with no need for subsequent boring or broaching.

On axles, shafts and machine tool components, previously made by metal chip removal, rotary forging achieves the shape by moving metal with reduced material loss. As-forged parts are as much as 36 percent lighter than conventional rough forgings; while metal flow continuity, unaffected by subsequent machining, results in greater strength.

designed for

PRODUCTION

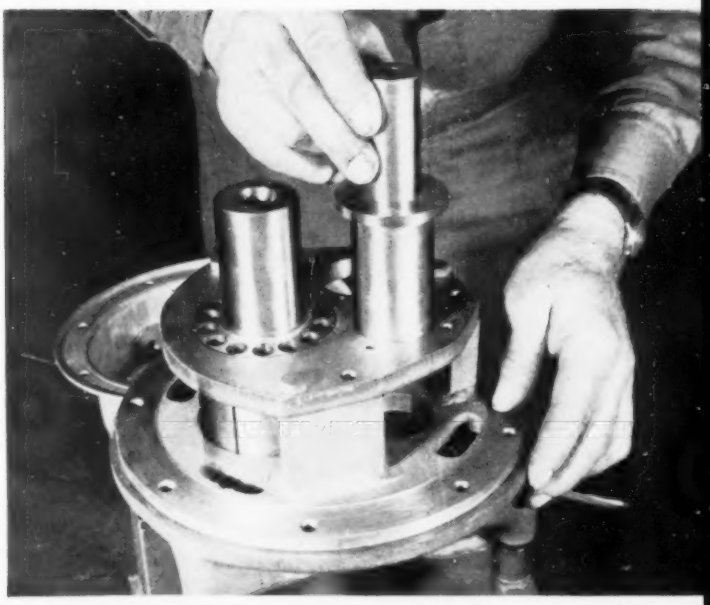
Expanding Mandrel Expedites Assembly

CROSS SECTION of the expanding mandrel with a cylindrical chucking surface on the outside of the body and a tapered surface inside.

Assembly of speed reducers begins with the alignment of the housings. The specific manufacturing problem is to align bores and maintain this alignment for drilling and reaming of dowel pin holes used in final assembly. A special expanding mandrel built by Scully-Jones and Co. solved this alignment problem.

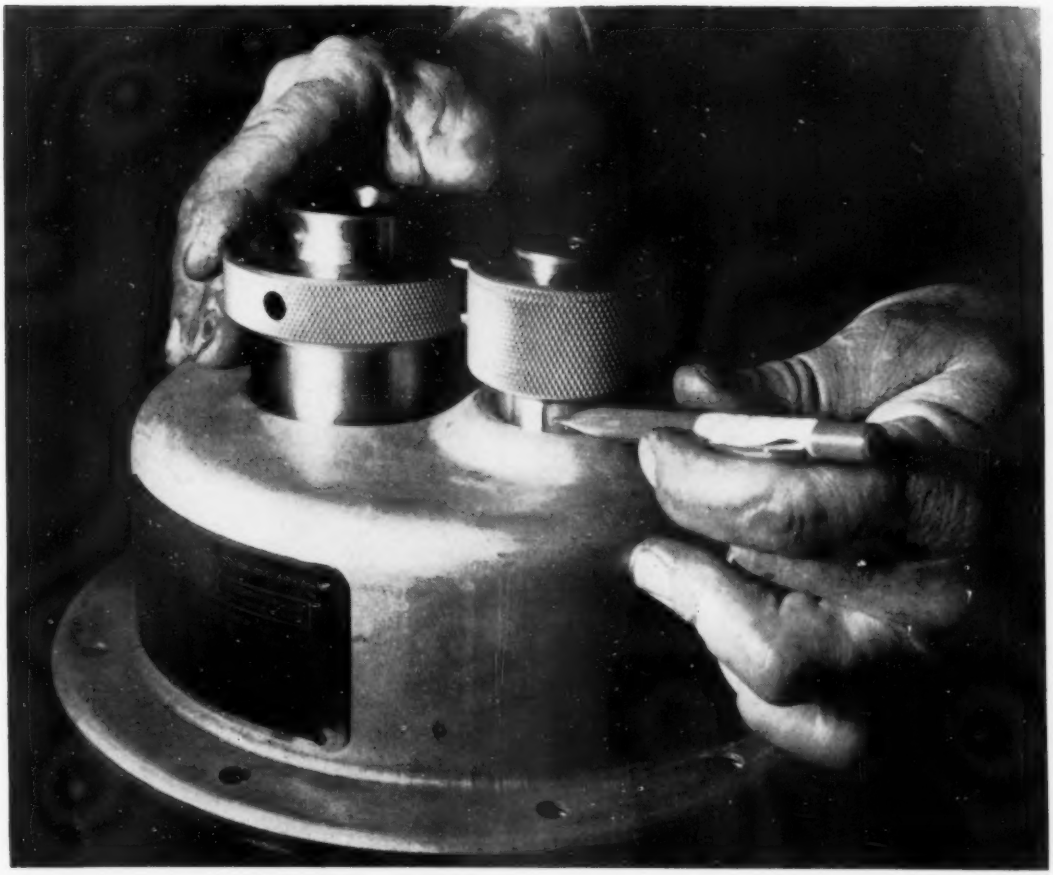
Construction of the mandrel consists of a taper sleeve, taper cone and rollers mounted in cages, as shown in the cross section, to apply the expansion force to the mandrel sleeve during operation. When the cylindrical sleeve of the mandrel is inserted into the hole in the workpiece, the operator turns the actuating cone and the spiraling motion of the rollers (held in the cage at an angle to the centerline) forces the cone to produce a wedging action between the tapers. This action expands the arbor body, eliminating all clearance evenly along the chucking surface. Location of the mandrel in the workpiece is similar to a shrink fit of a shaft in a hub.

SCULLY-JONES EXPANDING MANDREL with a built-up chucking surface being inserted in the through shaft bore of a gear reducer housing. When in place, the assembler expands the mandrel by tightening the actuating cone with an allen wrench.



GROUND PLUG being inserted into the drive-shaft holes before lining up seal bores.

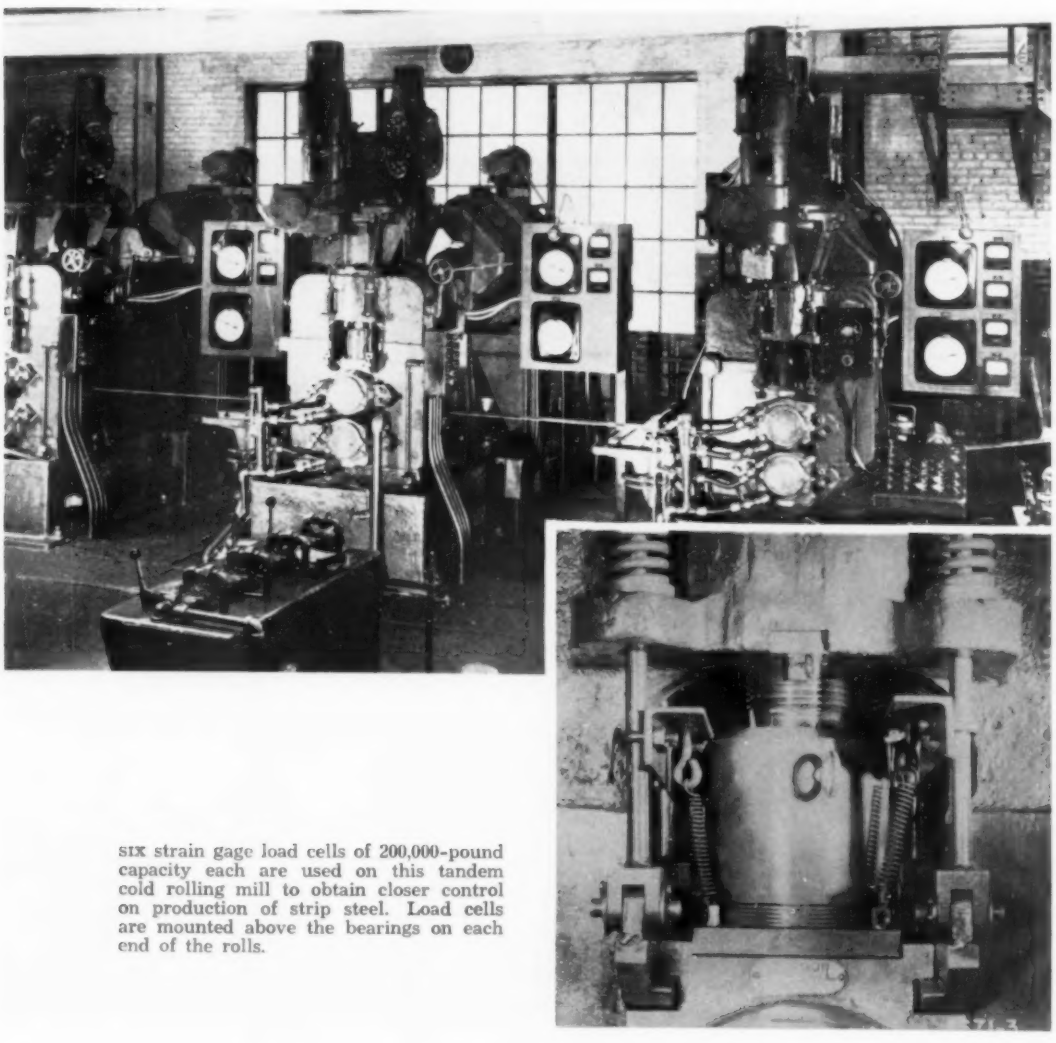
CORRECT CENTER DISTANCE is maintained after putting cover into place by slipping bushings over the expanding mandrel and ground plug. After alignment, dowel holes between the case components are drilled.



Strain Gages Control Sheet Metal Thickness

Strain gage cells, designed by Baldwin-Lima-Hamilton, are used to control rolling loads, material thickness, distribution of loads among the rolls and protect against bearing overloads.

The basic strain gage cell is made of four resistance wire strain gages connected as a Wheatstone bridge. They are attached to the machine member being stressed in proper orientation to transduce the force to a control device. Any strains produced by applied force unbalance the electrical bridge circuit and produce an output voltage proportional to the magnitude of the applied force. The same principles apply when the strain gage is used as a transducer of weight, pressure, torque and flow. Method of mounting load cells above the bearings on each end of the rolls is shown in inset.

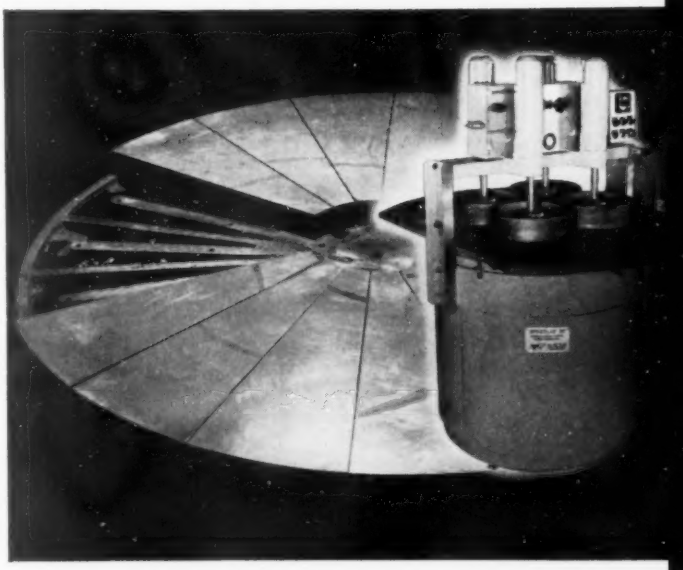


SIX strain gage load cells of 200,000-pound capacity each are used on this tandem cold rolling mill to obtain closer control on production of strip steel. Load cells are mounted above the bearings on each end of the rolls.

Flat Lapping Production Increased by Water Cooling

Relatively low production rates and distortion of lap plates due to heat build-up have prevented extensive use of flat lapping for production finishing. In a machine, designed by Speedlap Machine Div. of Abrading Systems Co., the base is internally water cooled to alleviate the heat build-up from rapid metal removal. Required flatness and surface finishes of one microinch rms can be obtained with stock removal rates equal to intermediate or finish grinding. Metal removal rates of 0.006 inch per hour on a load of 452 pieces without heat induction is common.

Basically, the cooling of the lap base is obtained from water flow through parallel cored passages in the base, as shown in the illustration. These are sealed by the lap plate segment, allowing the water to contact the back of the lap segment. Design of the cooling passages permits even cooling of the plate. A rotating joint in the hub allows free flow of the water while the machine is running.

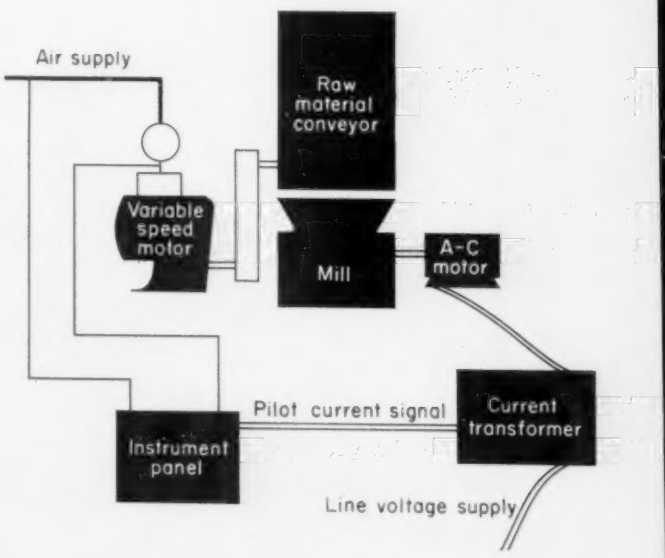


Control System Regulates Loading of Milling Equipment

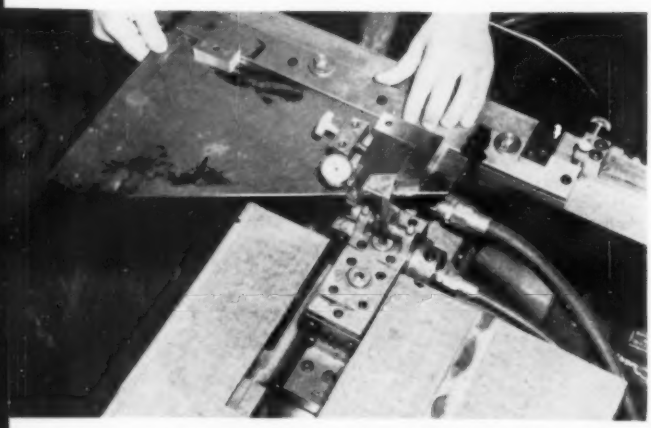
To obtain maximum efficiency of a grinding mill, the mill motor must be operated at constant horsepower. Using a feedback principle based on the horsepower consumption of the mill motor, U. S. Electrical Motors, Inc., has designed a load control system using a variable speed motor on the feed conveyor, a pneumatic actuator and a constant speed mill motor.

The horsepower varies with the amount of material received by the mill. Variations sensed in the current transformer attached to the mill motor circuit signal the pneumatic actuator to change the speed of the conveyor drive motor. Preset values for the mill motor are determined by the characteristics of the material being processed.

The system, shown in the sketch, will maintain the work load on the mill within 10 percent of the desired value. A simple dial control permits the load level to be shifted between 25 and 100 percent of the full load rating of the mill motor.



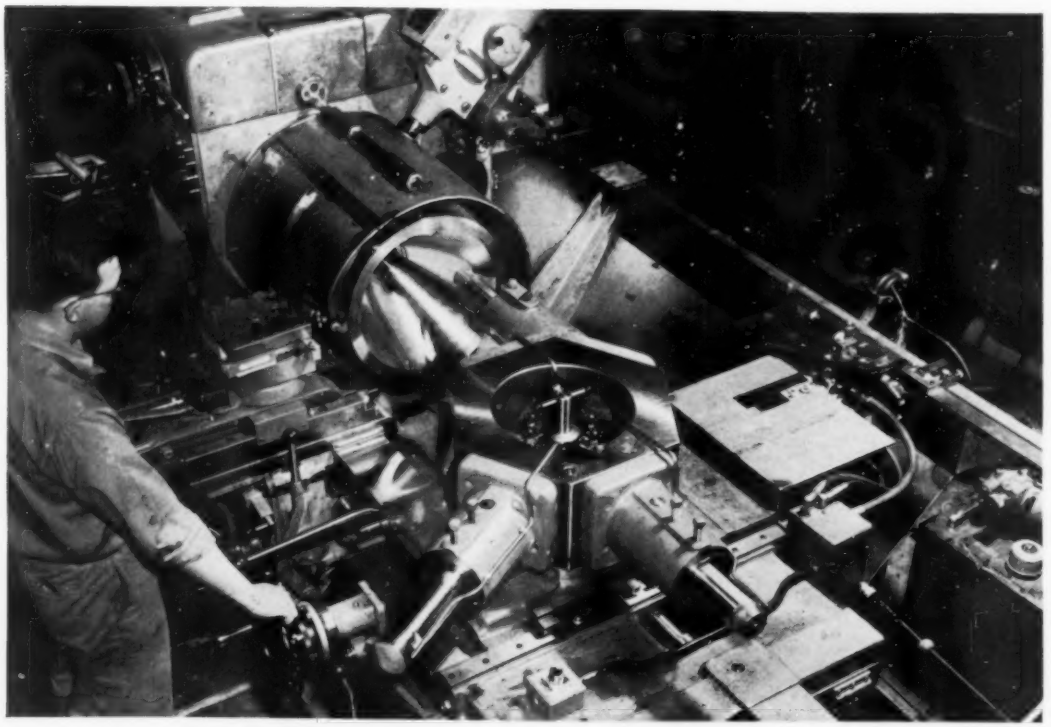
Template Gage Simplifies Tracing Lathe Setup



TEMPLATE SETUP GAGE being used to position a tracer stylus. After the tracing tool is in contact with the workpiece at the starting point, the template setting gage is brought up against the stylus and positioned by the indicator gage.

Pratt & Whitney Aircraft has expedited tracer lathe setup with a template setup gage used on a Gisholt Jetracer turret lathe.

Movement of the tracer stylus is controlled by a flat template mounted on a bracket at the rear of the cross-feeding hexagon turret carriage. The template is accurately positioned on the template carrier as shown in the illustrations. A special block with a dial indicator is clamped to the top of the template. When the tracing tool is in contact with the workpiece, the template is adjusted until the indicator contacts a flat on the stylus. This point indicates the exact starting position.



TRACER CONTROLLED TURRET LATHE being used to bore the contour on an aircraft part. Template and stylus are located at the rear of the machine.

POWER-ROLL FORMING: machining without chips

By John N. Heater
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Power-roll forming, also called Hydrospinning, Floturning, flow forming and power spinning, is a fast and accurate method of forming cones, tubes and other shapes. Characteristics and applications of the process as well as basic theory are covered by the author.

IN POWER-ROLL FORMING, metal is shaped to the contours of a revolving mandrel by rollers that exert pressure on the material. During the forming process, the rollers travel in a direction parallel to the axis of the mandrel, resulting in a forming action that can best be described as rotary extrusion, *Fig.* 1.

There are three basic techniques of power-roll forming: shear forming, tube forming and contour forming. Shear forming, used to produce conical shapes from disks, is governed by a rule known as the sine law. Thickness of the final cone wall is determined by the sine law, and is calculated by multiplying the original disk thickness by the sine of one-half the included cone angle. In tube forming, used for short, heavy wall tubes, thickness reductions are limited only by machine capacity and material formability. The term contour forming is used when surfaces deviate from straight-line conical or tubular forms. Both shear forming and tube forming may be involved in contour forming.

Shear forming was originally explained as a planar slippage phenomenon, similar to fanning out a deck of cards. Studies of microstructures show, however, that there are no flow lines parallel to the axis of rotation, as would be expected with planar slippage. Instead, there is a distinct grain orientation parallel to the cone wall. It is apparent that the forming action is extrusion occurring through the orifice between the mandrel surface and the forming roller.

Mechanism of Deformation: An ideal condition of extrusion is shown in *Fig.* 2. The metal ahead of and above the roller nose is undeformed. There is a zone of progressive extrusion around the roller nose and a state of complete deformation between the end of roller contact and the beginning of mandrel contact. This ideal condition is, of course, impossible, because the metal is uncontained in the vicinity of point *O* and no compressive deformation can take place in that area.

The condition of ideal extrusion must be modified to provide a practical representation of the mechanism of deformation, *Fig.* 3. Since metal flowing around the roller nose is initially uncontained and cannot be extruded, it is subject to bending alone. Extrusion begins after the material is trapped between the roller and the mandrel. There are actually two separate zones of deformation, one resulting from bending, the other from extrusion. Other factors that must be taken into account are upsetting of the metal by roller penetration, thinning by bending and tendency to forward extrude along the mandrel surface.

Probably the greatest dimension effect is due to thinning by bending. To develop a formula for

Abstracted from Paper 171, "The Challenging Future of Power Spinning," presented at the 26th ASTE Semiannual Meeting. Copies of the complete paper may be purchased from Society Headquarters.

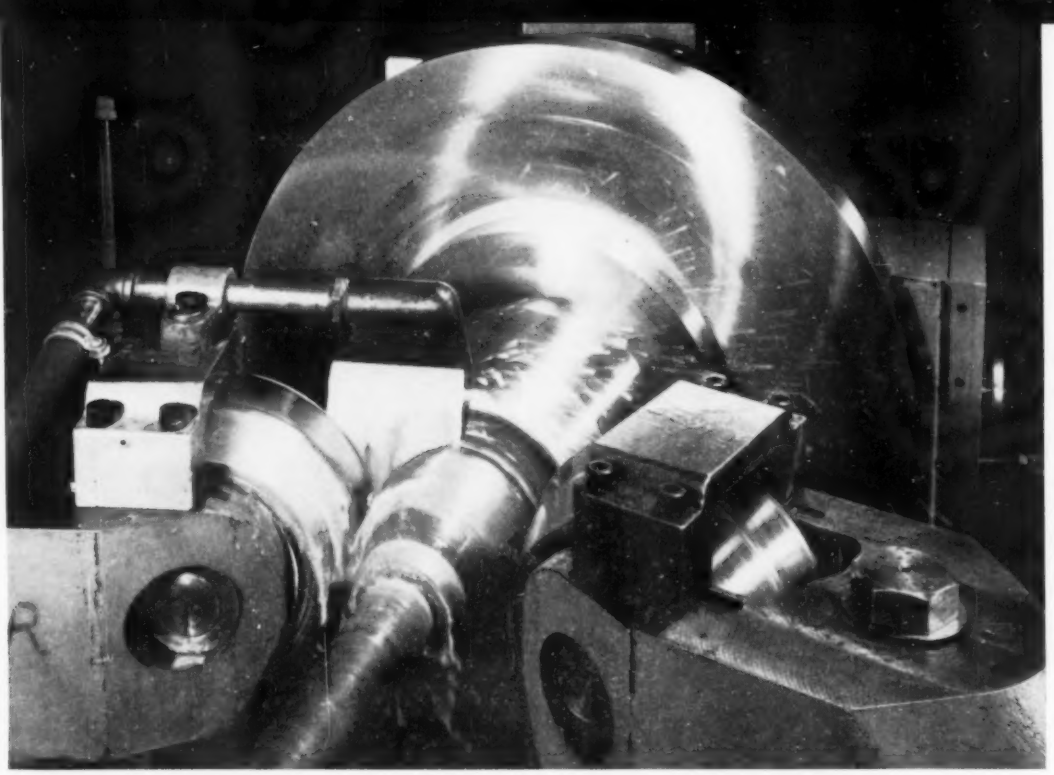


Fig. 1. Power-roll forming machine used to form an aircraft component. The opposed forming rollers maintain a constant thrust on the workpiece.

thinning as a function of the bend radius, the assumptions illustrated in *Fig.* 4 were made.

A free and unconstrained increment of width, W, being bent where the thickness, T, remains constant would produce a trapezoidal cross section. In this case, the outer fiber width, w, is taken as inversely proportional to its length with respect to the undeformed inner fiber. However, if the increment is laterally constrained during bending, the initial thickness is diminished to some lesser thickness. The rectangular cross section produced by this action has an area equal to the trapezoid.

Where the plate is bent to a zero radius, the unconstrained cross section becomes a triangle. The thickness of the equivalent constrained cross section becomes one-half the triangular altitude. An approximate formula for the thinning of the bent plate is:

$$t = \tfrac{1}{2} \frac{(2R + T)}{(R + T)}$$

where t = thickness of bent plate, T = thickness of original plate and R = radius of bend.

Determination of where the thinning begins be-

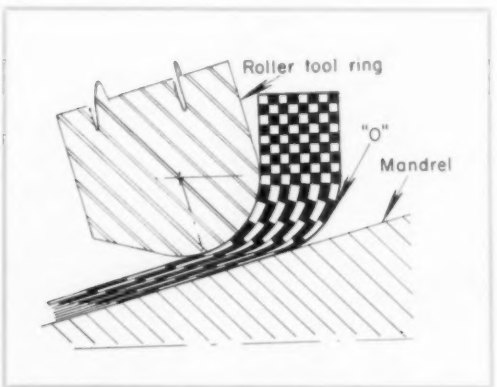


Fig. 2. Effect of power-roll forming on the workpiece when the forming is considered ideal extrusion without considering required confinement.

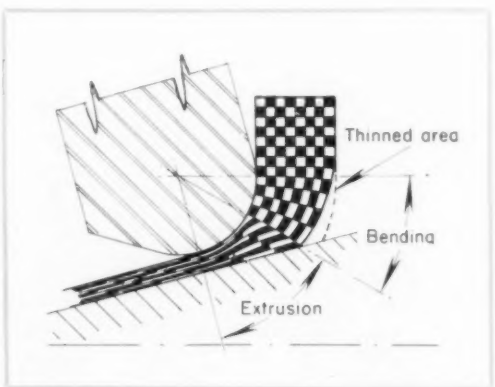


Fig. 3. More probable zoned bending and extrusion combination found in the workpiece during the roll forming operation.

fore the bend starts and continues to a maximum through an angle, γ, which is estimated at slightly less than 30 degree.

As an offshoot of the study of flow mechanics, the effect of the roller nose on the workpiece has been related to feed marks, as shown in *Fig. 5*. Surfaces produced by power-roll forming are highly burnished by the heavy rolling pressure, but feed marks are often quite prominent. A formula for calculating the height of feed marks is:

$$h = R - \tfrac{1}{2}\sqrt{4R^2 - f^2}$$

where h = height of feed mark, R = radius of roller tool nose and f = feed per revolution.

To illustrate, a roller with a nose radius of ¼ inch, fed at a rate of 0.060 ipr, leaves an 0.0018-inch high mark on the workpiece. By reducing the feed rate to 0.030 ipr, the feed mark will have a height of 0.0005 inch, or about one-third the height of the mark left at the faster rate. Larger roller radii diminish feed marks but increase force requirements rapidly.

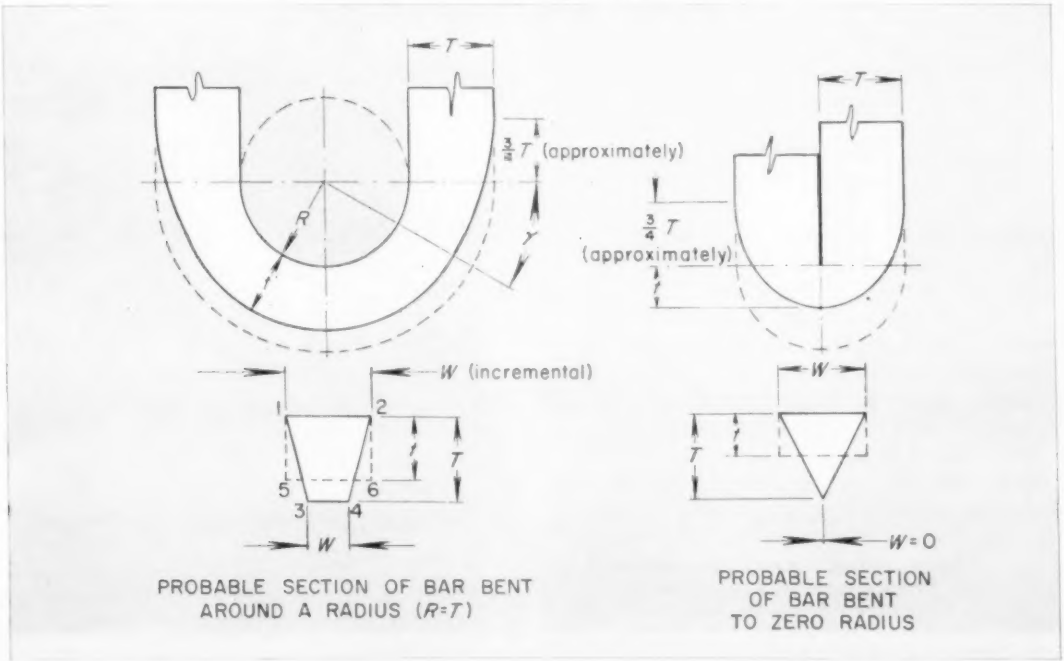
Applications: While rapid advances have been made in the development of the power forming techniques, refinements of the process are needed to help define practical imitations.

Precision elliptical, semielliptical and hemispherical pressure vessel components are difficult to form by conventional methods. The power-roll forming of hemispheres presents problems of sufficient magnitude to warrant extensive analysis. Rather small, thin-walled hemispheres can be produced from flat disks in a single pass where reductions of the wall approach 50 percent. Bowl-shaped preforms have been used successfully to make larger hemispheres, but when the metal thickness exceeds ¼ inch, the volume of metal displaced defies control.

Nozzle-shaped contours are another group of parts where the demand is increasing for large, heavy and accurate workpieces. Manual control is used to neck down the throat diameter from a cylindrical section. Extrusion is negligible, since tensile drawing is the predominant action. As the part diameter is drawn in or shrunk, control over metal flow and distribution is difficult to maintain by manual pressure. Tensile failure often results at the roller nose, or circumferential compression in the shrinking diameter promotes folding over of the metal. Eventually, the powerful but somewhat clumsy power spinning equipment must be controlled during operation to perform with the dexterity, skill and flexibility possible with manual spinning operations.

The virtues of preform accuracy have become apparent, especially when part length dimensions are affected. For example, it may be desirable to hold a close dimensional relationship between minor and major flanges of a conical part. Variation in preform wall thickness is evidenced as a variation in the finish length. Constant-volume increments of metal in the preform wall spin out to increased length at a given wall thickness. Awareness of this

Fig. 4. The effect of bending on plate thickness.



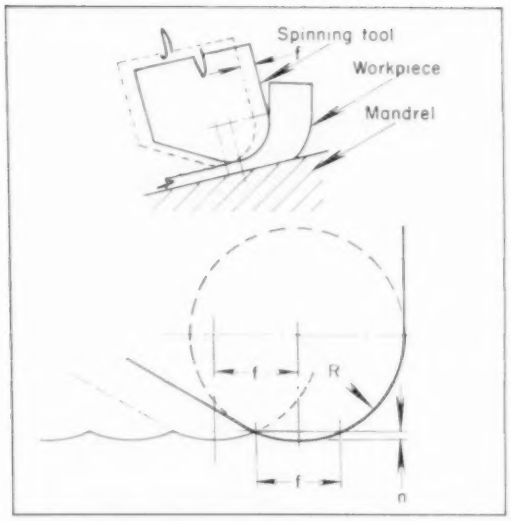


Fig. 5. The relationship of the factors used to determine the height of power-roll forming feed marks.

effect will stimulate adequate quality control measures for preform accuracy and condition.

Another production problem is the formation of heavy spiral patterns on both conical and tubular surfaces. In one case, these abberations occurred most frequently when part diameters approached some integer function of the forming roller diameter. Harmonic vibration frequencies were prime suspects, but investigation proved this assumption wrong. The cause was found to be the lateral freedom of the headstock bearing.

Basic theoretical investigation of system mechanics, empirical technique development and the metallurgy of cold work are inseparably bound together into the successful production of parts by power spinning. Undue emphasis has been placed on the empirical side of the problem. It is time to initiate more orderly theoretical investigations into the unknowns of all the so-called chipless machining processes. With research and development, the production potential of these processes will be multiplied.

'Bubble-Gum' Technique Provides Economical Forming

UNIFORM WALL THICKNESSES in plastics are being achieved economically with development of commercial equipment for air-slip thermoforming method.

Using this technique, a sheet of thermoplastic material is heated and softened, then blown into a predetermined sized bubble. The mold then is raised into the bubble's cavity, air exhausted, and the bubble collapsed around the mold. Uniformity of the wall thickness of the finished product grows from the fact that the prestretched plastic material does not touch the mold until the sheet is fully draped over it.

Equipment developed by Welding Engineers, Inc. to accomplish the job eliminates need to design walls thicker than necessary near the bottom of the mold in order to obtain a given thickness near the top where plastic tends to thin out. As a consequence, thinner sheets can be used in a short cycle operation with minimum waste.

Objects of all sizes can be formed by the technique; however, its advantages become more significant in larger pieces in which wall thickness variations are more pronounced.

Control of bubble size and shape permits varied thicknesses in walls for either sides or top of the mold to be obtained.

Type of product that can be formed on the air-slip forming machine is illustrated by this test molding of a refrigerator door liner made of Fortiflex, a rigid polyethylene created by Celanese Corp. of America.

METAL-CUTTING TESTS: *the input-output approach*

By David N. Smith
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Jones & Lamson Machine Co.
Springfield, Vt.

OBTAINING OPTIMUM RESULTS from metal-cutting operations—in terms of productivity, quality and piece costs—is of major importance to American industry. Numerous companies, research organizations and individuals are engaged in metal-cutting research. Unfortunately, from an industry-wide point of view, this research effort is not nearly as effective as it could be.

To get the greatest benefits from metal-cutting research, it is important that the attack be systematic, that the testing techniques and methods be of acceptable types, and that data be collected and reported in such ways as to make the exchange and correlation of information possible, easy and significant. At present, evaluation of results is difficult because of the many types of machining operations, the many variables that affect each type of operation, the wide variety of testing techniques possible and the great number of organizations and individuals engaged in metal-cutting research.

What is needed is some sort of master plan or framework for metal-cutting research. One way to construct such a framework is to visualize the metal-cutting operation as an input-output process, with all controllable variables as inputs and all the resulting effects as outputs. Metal-cutting operations are portrayed in this way in the chart appearing on the following page.

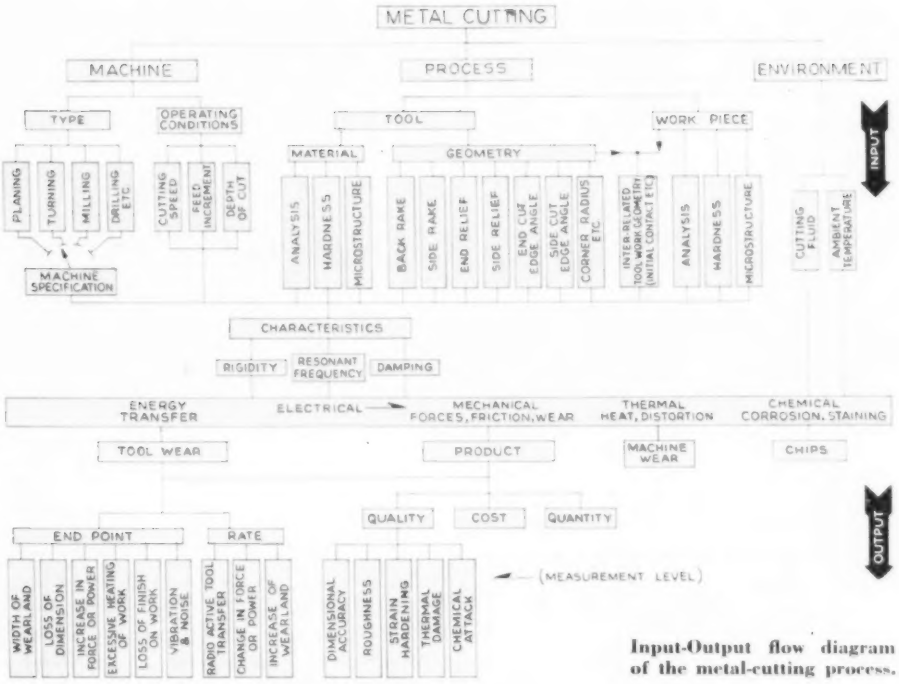
Input Variables: All input variables are grouped in one of three categories: *Machine*, *Process* and *Environment*. Under *Machine* the type of machine and operating conditions are specified. *Process* describes the nature of the cutting tool and workpiece, and their interrelated geometry. *Environment* deals with the external conditions under which cutting takes place. Each of these variables will be discussed in some detail.

There are, of course, many more types of machines than are indicated on the chart and appropriate substitutions can be made. Since there are important differences between machines, even when they are of the same general type, a complete specification is necessary. This important detail is frequently overlooked when describing a test. *Operating Conditions* are more likely to be covered in detail, and are, of course, essential information.

Many important factors in the *Process* category are frequently overlooked. Complete specification of the nature of the tool and workpiece, and their relationship, requires the tabulation of numerous details. Some of these factors are difficult to describe exactly. For instance, presumably equivalent grades of cutting tools vary considerably in performance. In refined metal-cutting tests, it is often observed that results vary from casting to casting, from bar to bar and even from one end of a bar to the other.

While this can be discouraging to an exacting research engineer who would like to achieve strict correlations between tests, it does emphasize the need for complete specification of tool and material characteristics in as precisely quantitative terms as possible. Hardness specifications alone may not be adequate. Tool performance is affected by microstructure, as well as hardness. Photomicrographs of the grain structures of both tool and workpiece materials are helpful.

Geometry of tools and workpieces must also be defined, for it is the geometry of engagement that matters. For instance, the effective end relief angle



Input-Output flow diagram of the metal-cutting process.

of a turning tool increases with smaller workpiece diameters, resulting in lower nose wear rates.

The third input category—*Environment*—includes many variables. With the specification of the cutting fluid, a description of methods of application must be included—hand applied, pressure applied and under what conditions—in solid, vapor or mist form. The importance of these factors is illustrated by the fact that flooding applications of cutting fluids are many times less effective than properly directed pressure applications. Ambient temperature conditions, which may range from the use of subzero media such as liquefied CO_2 to the use of heated cutting fluids, should also be specified, since they affect performance.

Machine and *Process* factors combine into *Characteristics*, which are not described at all in most metal-cutting research reports, but which are often the cause of effective or ineffective performance. The *Characteristics* involve the mechanical interrelationships between workpiece and tool.

The importance of these interrelationships is demonstrated by research with ceramic cutting tools. These tools are brittle and, consequently, are subject to chipping failure except in the case of continuous smooth cuts and rigid tool-workpiece setups. Little has been done to establish methods for describing such interrelationships quantitatively, but they are becoming more important as cutting speeds are increased and more brittle tool materials come into use.

Output Factors: All of the *Input Factors* are involved in the *Energy Transfer* process. This is typical of most, if not all, industrial processes—the use of energy or power to bring about desired changes. These changes can be expressed, for metalworking, in mechanical, thermal and chemical terms.

The items *Machine Wear* and *Chips* can be dismissed with relatively little attention, although neither can be ignored. *Tool Wear* and *Product Characteristics* are the primary measures of output. From these *Output Factors* test data from which to determine the optimum combination of input variables are obtained, making it possible to establish the best mode of operation for minimum over-all cost.

The "Input-Output" system provides a means of segregating and recording all of the factors involved in metal-cutting research operations. However, the problem of developing standardized test procedures remains. If significant and agreed-upon test procedures and techniques can be developed, metal-cutting research can be coordinated on a national scale. The many industrial, research and academic organizations that are engaged in metal-cutting research will be able to exchange data confidently. This will greatly accelerate metal-cutting research and help to substantially reduce the $10 billion annual cost of chip making in the United States. Most of the required techniques are at hand and the potential benefits are great.

evaluating the producibility of cold-extruded parts

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When producibility considerations are taken into account, the ability of the cold extrusion process to shape parts to finished dimensions with few secondary operations can be fully exploited.

THERE ARE FOUR POINTS which are important in considering cold extrusion of steel as a manufacturing process—tool design, product geometry or shape, product material and lubrication. Each of these factors is important and, of course, helps in determining the selection of processing methods.

Cold Working: There are two types of cold extrusion. Prior to considering product design and material specifications, it is necessary to consider both types and the basic end results which are gained from each type. Cold extrusion or plastic flow of steel is nothing more than cold working of the material, by plastic flow, without metal removal. This cold working results in the phenomenon of work hardening. Depending upon conditions, cold working is either an advantage or a disadvantage.

In the first type of cold extrusion, the phenomenon of cold work is utilized to produce products with higher physical properties than the base material. To explain this type of process, the process is used to cold work the material to product geometry or shape, and also to utilize the phenomenon of work hardening; thus resulting in a product of having better physical properties than the original material. Products formed by this method do not require heat treatment; also the use of high-strength alloys can sometimes be eliminated. A good example of this type of processing is the cold extrusion of military shell casings. The process is also used on other products requiring high strength.

In the second type of extrusion work hardening is a detriment, rather than an asset. The process is then used to create the dimensional shape of the product only. Such products usually do not require any heat treating or high physical properties.

On products of this type, cold extrusion is used to produce geometrical shapes only. As the work hardening is the result of plastic flow and cold working, sometimes it is necessary to anneal several times. The annealing operation softens the mate-

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Based on a talk, "Importance of Product Design and Material Specification in Tooling for Cold Extrusion of Steel," before the ASTE Saginaw Valley Chapter.

Bevel gear blank manufactured by cold extrusion shown top, bottom and cross section of finished profile. Experimental work is being done on the cold extrusion of a gear including the tooth forms.

rial, allowing it to regain its plastic properties. As cold work takes place the material becomes harder, or reduces the plasticity or its ability to flow. In general, the harder the material becomes, the more pressure is required to complete any work. In most of the common metals and materials, plastic flow properties are the best when the range from yield to ultimate strength is the greatest. Cold working properties are increased, or are more predominant, in the higher carbon and alloyed materials.

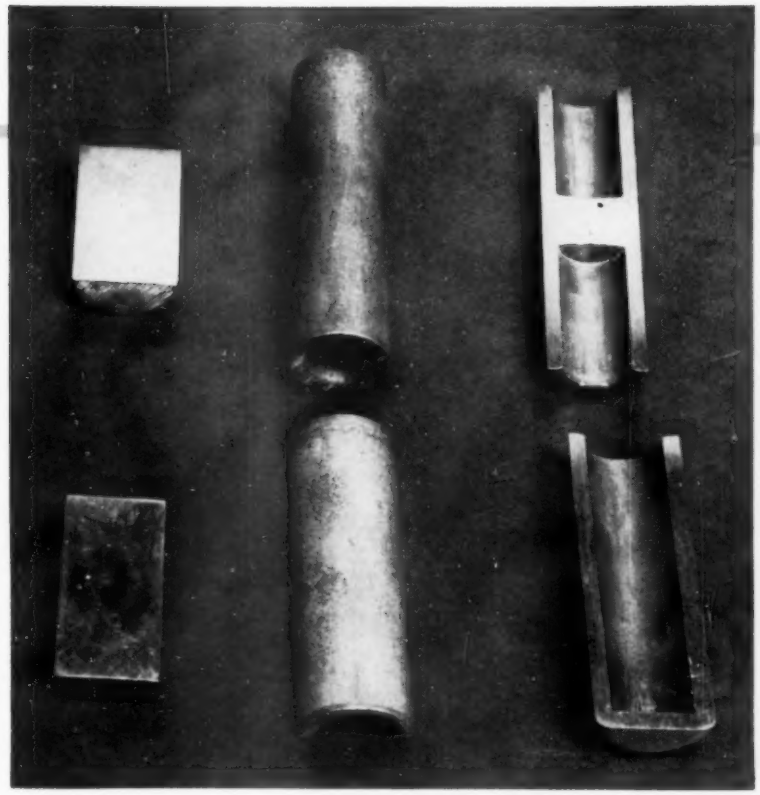
Producibility: Years ago when manufacturing methods were limited to sand casting and simple forging, and shop equipment limited to the standard lathe, drill and milling machine, the product engineer designed to these simple methods and machine tool units. Today, the types of manufacturing processes and equipment for these processes are many and complicated. Consideration of various processing methods is an important part of designing. Prototype designs should always be reviewed by process engineers for what is called "revision for manufacture" prior to finalizing the design and the production of tool units or manufacturing process. When designs are reviewed by process engineers many months and dollars are saved by product revisions to simplify manufacturing.

One of the important points in designing parts for cold extrusion is hole design. A hollow part, which could be an ideal extrusion, but has not been designed for extrusion, usually has a hole with a base profile normally produced by a standard drill point of 118-degree included angle. In almost every case, flattening this angle, eliminating shoulders and designating small corner radii facilitate cold extrusion processing.

Undercutting on both the inside and outside of a product usually cannot be produced by plastic flow because of general tooling configurations. In many cases, undercuts can be eliminated by utilizing the plastic flow process of thread-rolling or coining of base profiles. Long tapering surfaces add process operations when parts are to be cold extruded. The severity of work or reduction of the area, depth or length of the extrusion and alloy or carbon content of the steel material, are important factors which control punch design.

Most products which are being cold extruded require a machining operation after extrusion. This operation is used to produce undercuts, cut threads, trim to length, or similar operations. Such extruded products should be designed and processed so that one end is completed by extrusion. When parts are controlled in this manner, one chucking setup at the completed end on automatic chucking lathes or screw machines will allow complete finishing of the opposite end with multiple tooling in one machine tool. When this type of processing and product design is followed, manufacturing operations and cost are kept at a minimum.

Co'd extrusions can be completed in closed cavity dies, controlling all dimensions to close tolerances. Careful consideration must be given to the slug producing operations for closed die extrusion. The manufacturing tolerances must be held to very close units. As the plastic flow operation is nothing more than displacement, exact volumes must be obtained for a closed-cavity extrusion. A product and process evaluation should always be made to check costs of producing slugs to exact volumes versus



Two products made in one press stroke from solid slugs in conventional press equipment. In each case, the original slug was slightly smaller in diameter than the finished part.

the costs of producing slugs that have a large size tolerance. It may be more economical to produce parts in open-cavity dies and then trim to length.

Secondary Operations: There are many products that can be completed as an extrusion, not requiring additional operations. On parts of this type, extrusion design should allow a maximum-length tolerance at one end. As cold extrusion is nothing more than displacement forming, the original slug volume determines the length of the extruded product. Slugs are often controlled by weight checking during the manufacturing cycle to eliminate complicated dimensional checking.

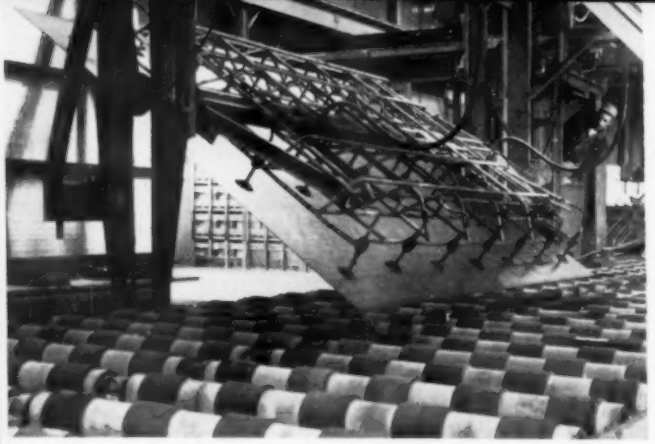
In most extrusion jobs, the material is placed in compression to cause plastic flow. After flowing through die orifices the material is no longer subjected to any further stresses. Due to the fact that the material is in compression, surface or internal defects within the material do not propagate or open up during the flow process.

For this reason, hot rolled steel may be used without any special surface preparation. Again, the type and degree of cold work must be considered.

The only time surface condition of the slug becomes of prime importance is when the material is placed by plastic flow in tension during the plastic flow process. At this time, due to the weakness created by the defect, and the fact that the defect also causes a strain concentration or notch effect area, tension will cause it to open up, causing a structural failure and uneven flow in the product.

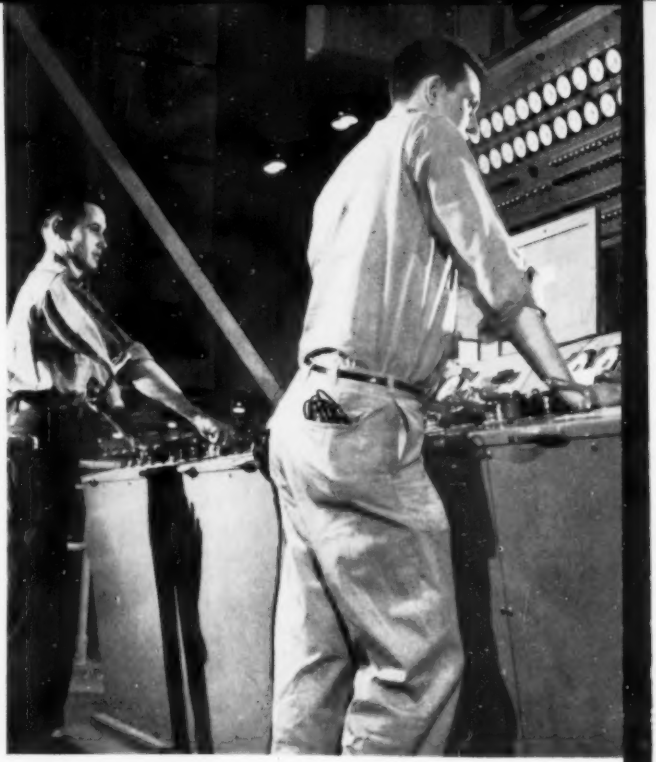
Material Specifications: Up to two or three years ago, material control and specification was though to be the most important factor of control for cold extruded parts. Aluminum killed steel was thought necessary; grain size had to be fine, from 5 to 7 ASTM; quality required was specified as "cold extrusion quality steel"; it was thought that the material had to be in a completely spheroidized condition prior to extrusion.

At the present time many products are being extruded on production lines from silicon killed material and rimmed steel; grain size is not considered. Cold heading quality, rather than cold extruding quality steel is also being used. The annealed condition is utilized as a "process anneal," rather than the costly spheroidizing process. So-called "secret techniques" of cold extrusion have been developed. Tooling and processing for cold extrusion, however, are not mysterious. An understanding of the requirements and results of the process involves the application of known—and simple—engineering principles. Tooling designed on those principles gives sound results.



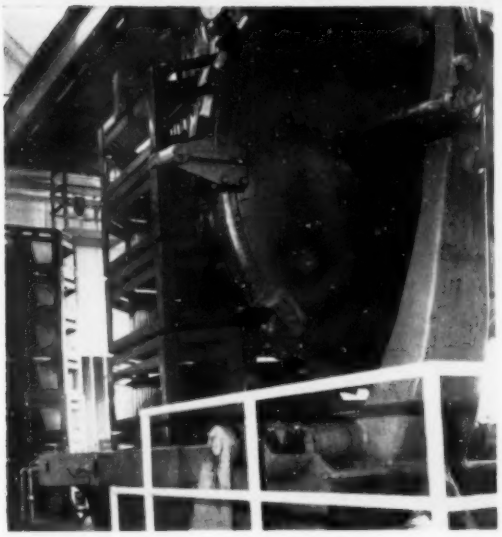
AFTER COOLING, ribbon of glass from furnace is cut into 120 by 170-inch pieces. Glass is then lifted from conveyor by a vacuum fixture and either stored on vertical racks as shown here or transported directly to a 4000-foot-long grinding and polishing line. End product is glass of optical quality for Ford and Mercury windshields.

RIBBON OF GLASS at 2240 F passes between water-cooled rollers as it emerges from a furnace at Ford Motor Co.'s new Nashville Glass Plant. Attendant in protective clothing continuously inspects glass and rolling equipment. The glass is cooled gradually to 150 F in a 430-foot-long annealing lehr.



TWO THOUSAND FEET APART at each end of the grinding and polishing line at the Nashville glass plant are multisignal control panels, used to keep glass moving through the line in synchronization. By signals from lights and dials, operators are able to control the line. They communicate with the team at the opposite end of the line through a speaker system to coordinate the operation.

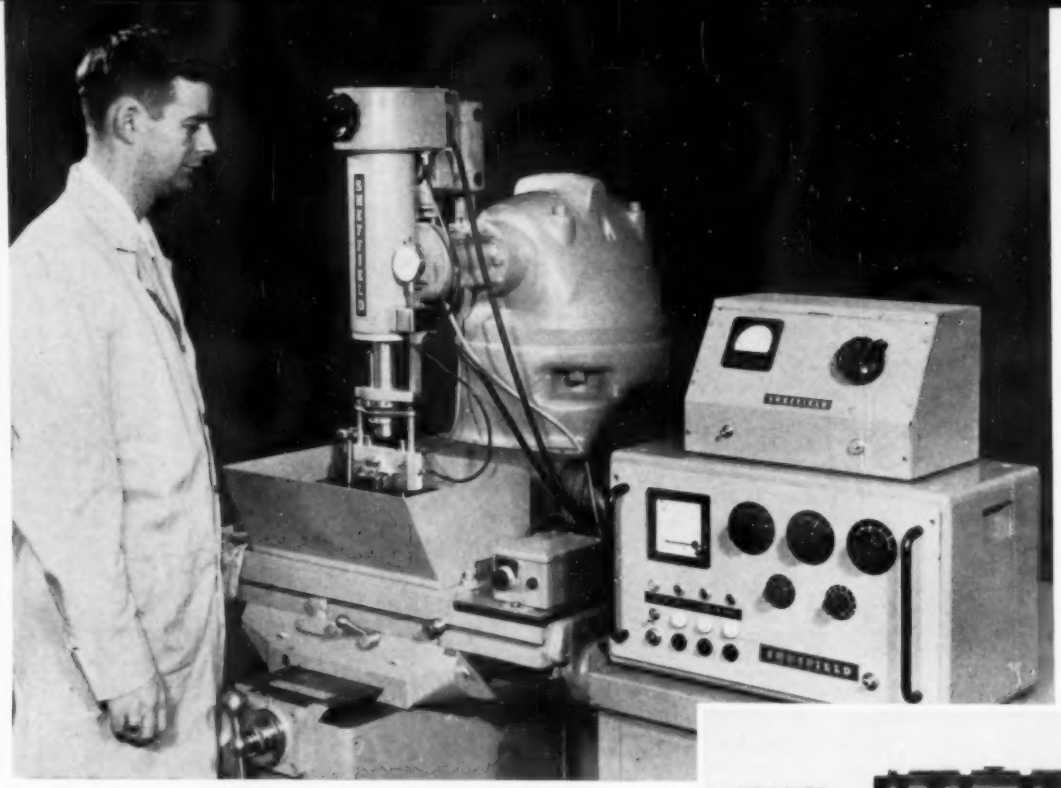
TOOLS at work

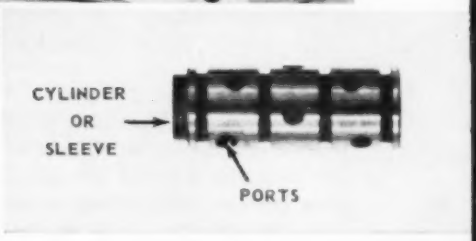


AFTER POLISHING, plate glass is cut into windshields. Wrap-around shape is obtained by passing windshields through furnace on curved fixtures. As the glass is heated, it becomes semiplastic and sags to assume the shape of the fixtures. To make a laminated safety glass sandwich, vinyl sheet is placed between inner and outer windshield sections. Racks of windshields are then lowered into autoclaves—giant pressure cookers—where heat and pressure of impregnating oil bond the sandwich. Here a crane operator is lowering racks into autoclave.

TO AVOID NICKS and scratches, windshields are handled manually at Ford Nashville Glass Plant. Here completed windshields, still covered with a film of oil from the autoclave, are taken from a belt conveyor and loaded onto a conveyor fixture that will carry them through washing and inspection operations.

ALL WINDSHIELDS produced by Ford Glass Plant must pass critical inspections before being approved for shipment to assembly plants throughout the country. At this point, banks of fluorescent lights that show defects better than sunlight are trained on windshields as conveyor slowly passes before an inspector.

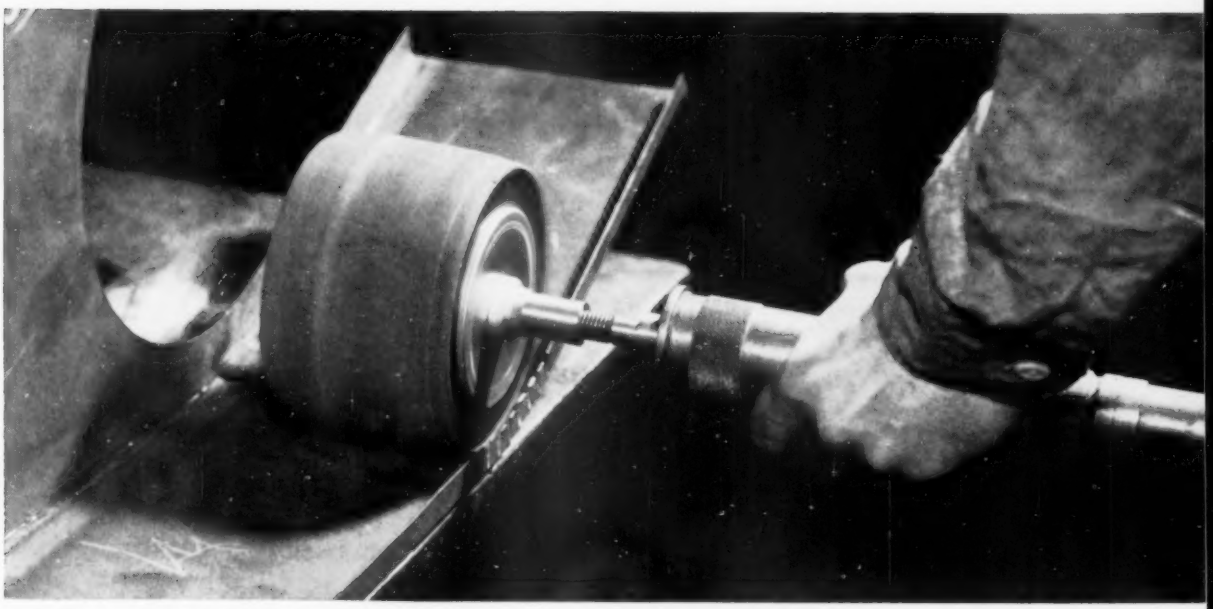




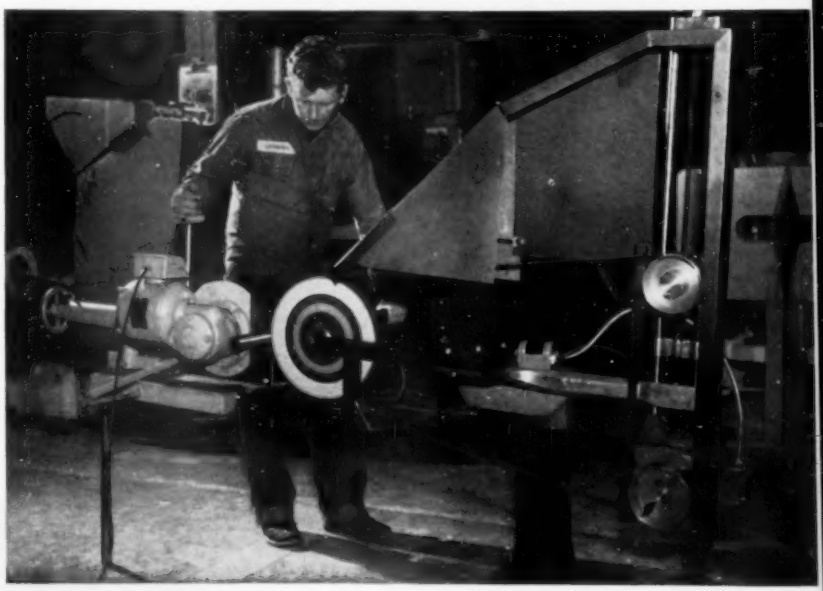
"ELECTRICAL" MACHINING METHODS are used to rough and finish machine port cavities of sleeves for precision servo valves (inset) at the Sheffield Corp. Here ports are rough machined, four at a time, on an electrical discharge machine. From 0.007 to 0.008 inch of stock is left for finish machining operations.

SHEFFIELD-CAVITRON ultrasonic machine finishes four ports in valve sleeve to exact size and surface finish. Finished port size is 0.056 by 0.156 inch. A 30-power microscope is used to inspect the sharpness of porting edges and corner radii. A Bendix ultrasonic cleaning unit uses high-frequency sound waves to remove any vestiges of dirt, oil or other foreign matter from these parts.

TOOLS at work



INFLATABLE RUBBER WHEEL on portable grinder allows abrasive band to conform to the shape of irregular workpieces. By varying the pressure, the action can be adjusted from rough grinding to finish polishing. Unit is made by Nu-matic Grinder, Inc., Cleveland, Ohio.

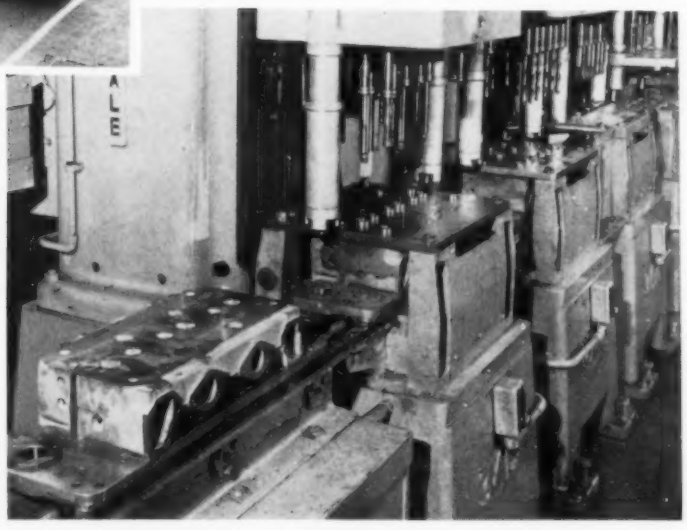


ACCESSORY UNIT converts a standard abrasive-belt polisher into a centerless grinder that accepts work from 1/4 inch to 14 inches in diameter. A rubber drive wheel rotates and feeds the workpiece. Equipment is made by Stephen Bader & Co., Valley Falls, N. Y.

WITH THE INTRODUCTION of a new type of Diesel engine, a British firm, A. E. C. Ltd., of Southall, England, re-equipped a factory section for production of cylinder heads and engine blocks. Despite the low production volumes (three engines per hour) mechanization has been extensively employed. Also, all machines are tooled so that drilling and boring heads, and work locating fixtures can be easily removed and replaced by similar equipment for producing alternative types of engines. Here a cylinder head is being machined on both faces on a twin-spindle rotary-table milling machine. After machining, parts roll to succeeding operations on conveyor.

TOOLS at work

BATTERY of six automatic drilling machines completes all drilling, spot facing and other operations on valve guide holes and ports of one side of block. A rollover device inverts castings before they pass through a second battery of machines that completes drilling operations on the manifold and water jacket cover faces.



CYLINDER HEAD mounted on platen at A. E. C., Ltd., prior to indexing into battery of drilling machines. Bushing plate and multiple-spindle attachments can be readily removed and replaced to accommodate other cylinder head designs.

effects of
OPERATING VARIABLES
....on abrasive belt life

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When the characteristics of abrasive belts are understood, their ability to remove metal quickly and economically can be exploited to the fullest extent. The author, an expert in abrasive belt applications, lists and explains the most significant factors affecting belt life.

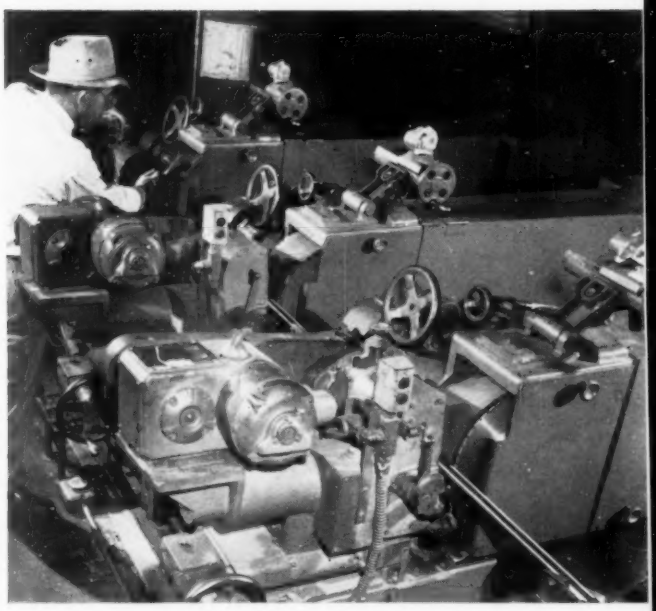

Fig. 1. Centerless OD grinder, utilizing coated abrasive belts for dimensioning and for final polishing.

ABRASIVE BELT MACHINING is characterized by high stock-removal rates, generating excellent surface finishes. These advantages have led to a host of applications during the past several years. An example is the centerless OD grinding operation shown in *Fig.* 1. Final dimensions and finishes are achieved in one pass through the machine at a feed speed of 1000 fph. The high speed of the operation is due to the ability of coated abrasive belts to remove stock without excessive heating.

Wide abrasive belts can remove stock from the full width of a large workpiece without the need for a massive and complex support mechanism. Belts up to 100 inches wide are used for such operations. The grinder pictured in *Fig.* 2 generates level surfaces or single or compound tapers on aluminum sheets. Even with the large area of contact between the belt and the work, the stock-removal rate is high and the method is extremely economical.

Belt Wear: In order to obtain full efficiency from abrasive belts, it is important to carefully consider operating variables in terms of both rate of cutting and belt life. Two mechanisms by which abrasive grains wear down are fracturing and attrition. Much of the wear due to mechanical fracturing takes place within seconds after the belt has been applied to a workpiece.

During belt operation the small cutting points of abrasive are heated by friction to temperatures approaching the melting point of the material they are cutting. The heating takes place in a very short time because of the surface speed of the abrasive belt and the short path of the mineral grain through the work. The rate of cooling to ambient temperature is nearly as rapid. Thermal gradients within

Abstracted from paper 146, "Coated Abrasive Machining" presented at the 26th ASTE Semiannual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

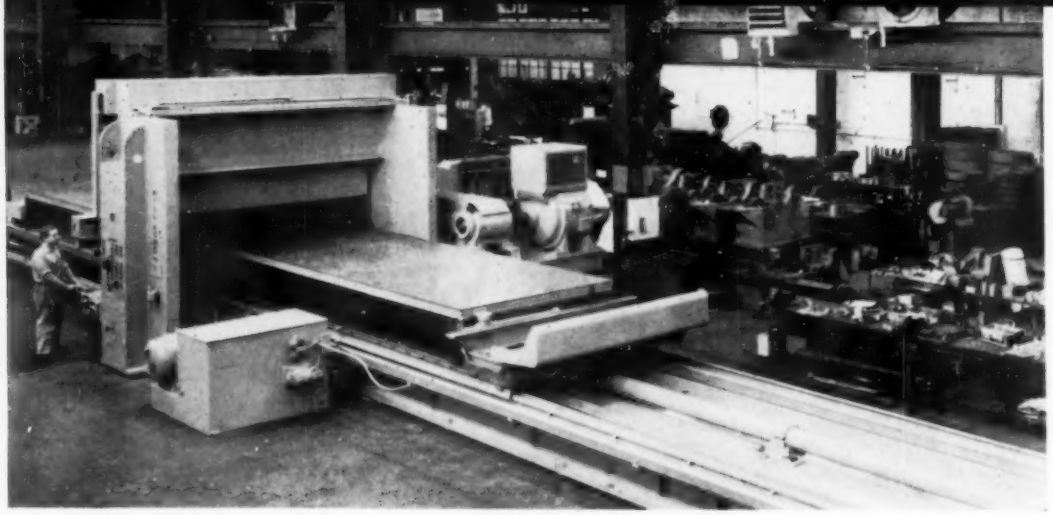

Fig. 2. (above) Abrasive belt machine for producing finished flat or tapered surfaces on aluminum sheets. Table is 84 inches wide, 40 feet long.

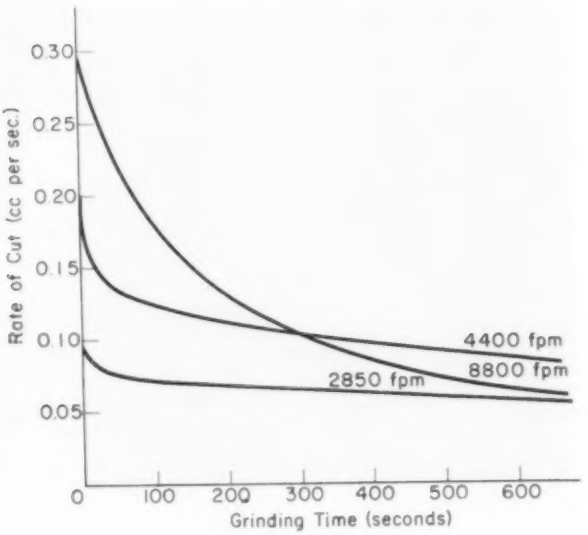

Fig. 3. (left) effect of speed on gray cast-iron grinding rates. Workpiece is Meehanite GC cast iron, lubricated with air. The abrasive belts are 60-grit aluminum oxide run at constant load.

the grains are high and can result in progressive small fractures. Aluminum oxide is more subject to thermal fracturing than silicon carbide because of lower thermal conductivity and higher coefficient of thermal expansion. Fracturing does not have a direct or marked effect on the rate of cut since it leaves sharp edges on the mineral grains.

Attritional wear may be due to chemical or physicochemical breakdown of the grain at the point of contact with the work. This breakdown may be in the form of melting or other phase changes, chemical decomposition, or oxidation. Attrition may also be caused by loss of microscopic fragments that weld to the work. Seizure is promoted by chemical bonds formed between the work material and the abrasive mineral.

Each of these attritional wear processes results in loss of sharp edges and points of the abrasive. Such attrition is particularly noticeable in silicon carbide when cutting steel. There is reason to suspect that attritional wear slows down once a polished flat of fairly small area has been established on the abrasive grain. As the flat area increases, the unit pressure decreases and heat is not so readily dispersed.

"Shelling" is a wear process in which mineral grains are lost from the abrasive belt. It is caused by the inability of the bonding agent to retain the grains. This type of wear indicates that the wrong type of belt is being used; the work pressure is too high; or that the backup is not resilient enough.

Filling, a process in which residue from the workpiece builds up between mineral grains, is not a major problem when belt grinding hard metals. It does occur occasionally with soft, ductile metals, but usually not until after long belt service.

Load: Load is the force normal to the abrasive surface that presses the work against the belt. Since the rate of cut is, within limits, directly proportional to the load, it is important to use high loads in stock-removal operations. Hence, heavy-duty belts are frequently the most economical in terms of grinding cost per part.

Speed: Speed is the velocity of the cutting particles relative to the work. The instantaneous rate of cut is proportional to speed, again within limits. The rate of wear on the mineral grains is proportional to some power of the speed greater than unity. At some high speed the deleterious effect on the wear rate becomes dominant over the beneficial effect on the instantaneous rate of cut. This limiting speed is fairly low for metals such as titanium

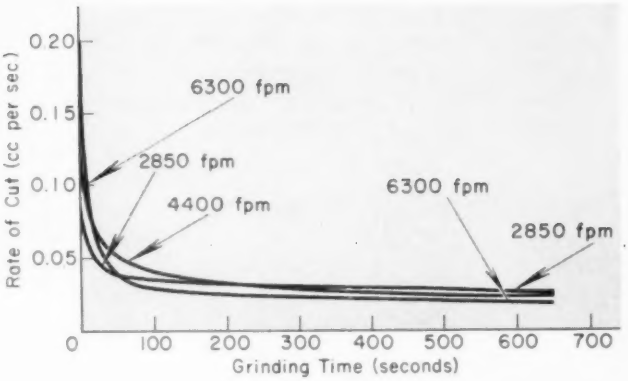

Fig. 4. Effect of speed on titanium grinding rates. Workpiece is titanium alloy 6A6-4V, lubricated with tripotassium phosphate solution. Belts are 60-grit silicon carbide run at constant load. Optimum speed is lower than for gray cast iron as shown in *Fig.* 3.

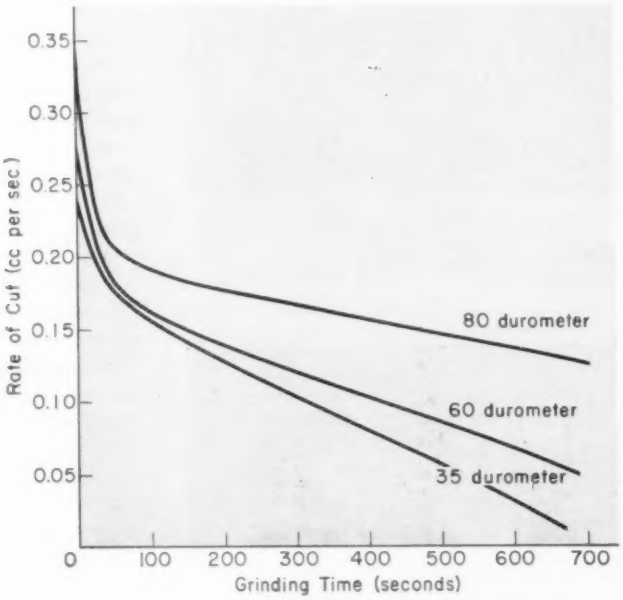

Fig. 5. Effect of contact wheel durometer hardness on mild steel grinding rates. Workpieces are 1020 cold-rolled steel, lubricated with air. Belts are 60-grit aluminum oxide run at constant load.

or zirconium, which become highly reactive at elevated temperatures, and for gray cast iron. *Fig.* 3 shows rates of cut for cast iron and *Fig.* 4 shows rates of cut for titanium at various speeds.

Speed must be restricted when, as in titanium grinding, a lubricant is used to reduce the rate of wear on the abrasive. Every externally applied lubricant requires some small amount of time to film over the surface being cut. This limits the belt speed. On the other hand, the effectiveness of even viscous lubricants appears to be increased by the use of high speeds. Since high cutting speeds frequently give improved surface finish, they are favored for polishing operations.

Backups and Supports: Many mechanical devices are employed for backing up coated abrasive belts, including rigid metal platens or rollers, and flexible contact wheels made of metal or cloth. In general, resilient backup materials are useful in high-pressure work to prevent shelling, for producing finer finishes or to enable the belt to conform to a contour. For increased stock removal, harder, smaller diameter and radically serrated contact wheels are used. The effect of contact wheel hardness is shown in *Fig.* 5.

For operations where close control of the dimension or flatness of a ground surface must be maintained, a backup plate or wheel having virtually no

resilience is used. In many operations, a combination of features is sought and a compromise must be found. For example, a serrated rubber contact wheel 14 inches in diameter with an 80 to 90 durometer hardness, is a good compromise for aggressive stock removal at heavy pressures, allowing good dimensional control and fair finishes.

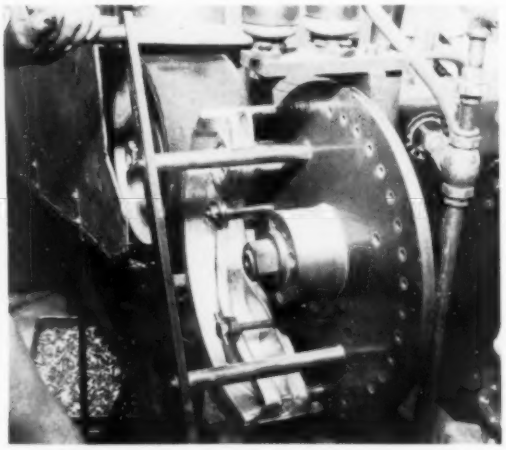

Fig. 6. Lubrication of this grit 40 abrasive belt boosted production from 35 pieces to 140. The belt generates final OD surface on gravity die cast aluminum brake shoe.

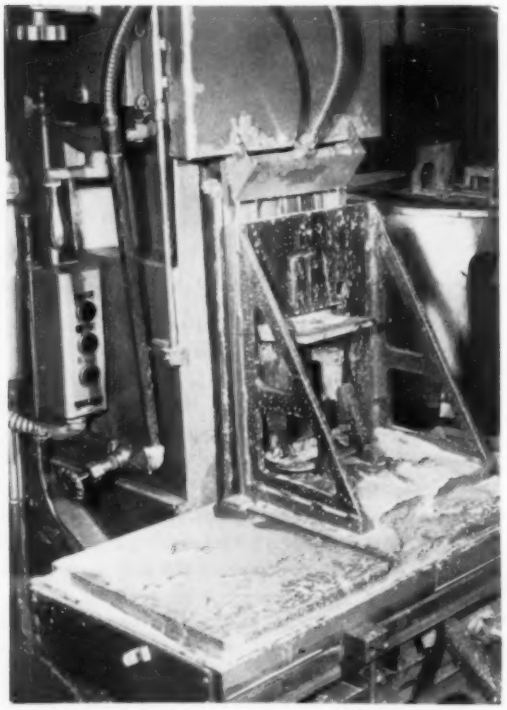

Fig. 7. Abrasive belt stationary platen grinder finishing magnesium casting. Lubrication aids finish, cools workpiece and extends belt life.

Lubrication: The use of lubricants in grinding is very important in achieving fine finish, for cooling the work, for reducing the rate of mineral attrition and, in some instances, for reducing abrasive filling. In one instance in which an aluminum brake shoe was being finished with a 40-grit resin bond aluminum oxide coated abrasive belt, *Fig.* 6, belt life was increased from 35 to 140 pieces by use of an extreme-pressure organic lubricant. The lubricant prevented adhesion of the metal to the belt, thereby reducing the effects of dulling and filling. The lubricant was sprayed periodically onto the belt. This particular operation is also interesting because it shows how a simple backstand grinder has been adapted to do a precise job.

A stationary platen grinder with a self-contained lubricating system is shown in *Fig.* 7. It is used to generate a plane surface on widely spaced ribs of a magnesium casting.

A suitable lubricant gives fifty-fold improvement in belt performance over nonlubricated conditions when cutting titanium. A ten-fold improvement has resulted from finding a good lubricant for a nickel-base superalloy. These improvements apparently are due to a film of lubricant between the mineral and the metal, which inhibits or slows down the attrition of the sharp cutting points.

Much grinding of ferrous metals is done dry with aluminum-oxide abrasives. A good grinding lubricant—atmospheric oxygen—is actually present in this system. Laboratory studies disclose that when air is displaced by pure nitrogen or carbon dioxide or some other inert gas, the rate of cut of steel drops off greatly. Finding a lubricant for steel that will improve abrasive performance involves not only finding a good lubricant, but finding one that is better than oxygen. For this reason, large improvements over dry grinding performance are not the rule with ferrous alloys. Gray iron differs from steel in many respects, though not in this one. It is difficult to better dry stock removal performance with cast iron by using any lubricant.

Silicon carbide abrasives give higher performance on gray cast iron than they do on steel. This has been attributed to silicon and carbon contents. Since these constituents are closer to saturation in cast iron than they are in steel, the cast-iron-silicon carbide combination is less reactive. The "internal" lubrication of gray iron by graphite is also considered to be an important factor.

Optimum belt performance can be achieved only by a knowledge of both the potentials and limitations of coated abrasives. Mechanically severe operations give desirable rates of cut and adaptability to special requirements, but may require careful specification of belt backup (contact wheel or platen) and construction for best economics. Careful consideration of lubricants, minerals, belt speed, etc., point the way to better belt life.

Rapid Evaluation of CUTTING TOOLS

By L. B. Zylstra
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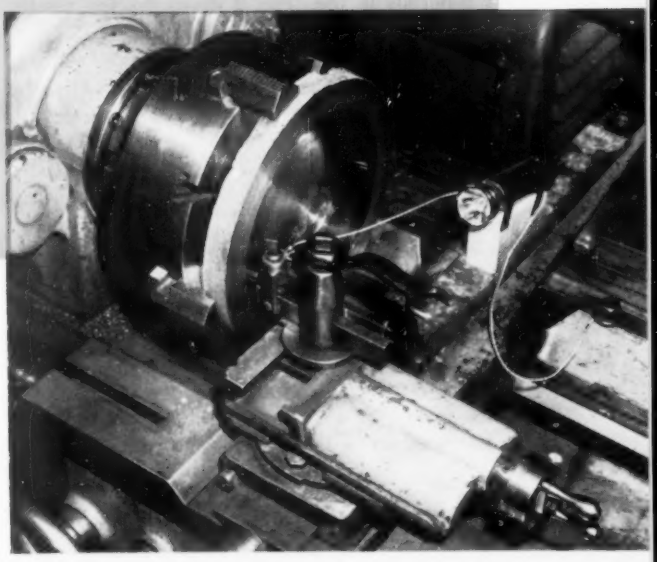

Fig. 1. Performing facing test to compare tool-life characteristics of cutting-tool materials. Tool failure is reached at a predetermined tool-wear value. An electrical contact mounted on the tool post touches the disk and lights the flashlight when the depth of cut is reduced by an amount equal to the tool wear allowed.

Extensive tool life testing takes time and money. A simple procedure, developed by the author, makes it possible to quickly compare various cutting tools to see if extensive testing is justifiable.

MANY MODERN MACHINE TOOLS represent a large capital expenditure. Some special purpose machines have high hourly machine charges. Productivity of these machines must be maintained at high levels to insure economical operation. It is imperative, therefore, that the life of cutting-tool materials be examined constantly and thoroughly.

Cost and time considerations prohibit exhaustive qualification tests on all new tool materials. Ignoring the possibility of a savings to be gained by using a new material is equally impractical. Thus it is desirable to have available a low-cost, rapid method of separating materials with definite possibilities for use from those unworthy of consideration. Such a method has been developed in the machine tool laboratories of the mechanical engineering department at the University of Washington.

Tool Life Tests: Other things being equal, tool life is a function of cutting speed. The speed selected for a given operation depends on a balance between machine costs and operator's wages on one hand, and tool, grinding and setup costs on the other. Tests of new cutting-tool materials usually consist of turning diameters on metal shafts at various combinations of feed, speed, depth of cut and tool geometry. Results are expressed in terms of tool life at a given cutting velocity.

Facing Test: The method developed at the University of Washington consists of facing a 12-inch disk of a suitable material such as cast iron on an engine lathe, *Fig.* 1. Compared with conventional tool-life tests, the facing method saves time and material and does not require special equipment. The tool to be tested is set with its axis perpendicular to the workpiece with the cutting edge at the centerline of the lathe spindle. The tool is fed into the work from a hole in the center of the disk. The size of the hole is compatible with the side relief angle of the tool. Spindle speed of the lathe during testing is high enough to cause failure of the tool

before the cut progresses to the outer edge of the disk. By repeating the cuts with several spindle speeds, enough information can be obtained to roughly judge various cutting tool materials.

Representative Study: The facing test served recently to evaluate claims that a new high-speed-steel material would give three times the tool life of materials in use. *Fig.* 2 shows the test results.

Procedure: The machine used for the test was a 17-inch Boye & Emmes engine lathe with a five-hp motor. The workpiece was a 12-inch diameter disk made of cast iron corresponding to ASTM class A126. All tools were prepared in the same manner to the same geometry. The tools had a zero-degree back-rake angle; six-degree side-rake, end-relief, side-relief and end-cutting edge angles; zero-degree side-cutting edge angle and a $\frac{3}{32}$-inch nose radius. The workpiece was chucked and centered in the engine lathe. A one-inch hole was drilled in the piece and then enlarged to a diameter of $1\frac{7}{8}$ inches. The workpiece was then faced with a cemented carbide tool to a depth of $\frac{3}{16}$ inch to eliminate surface effects of the casting.

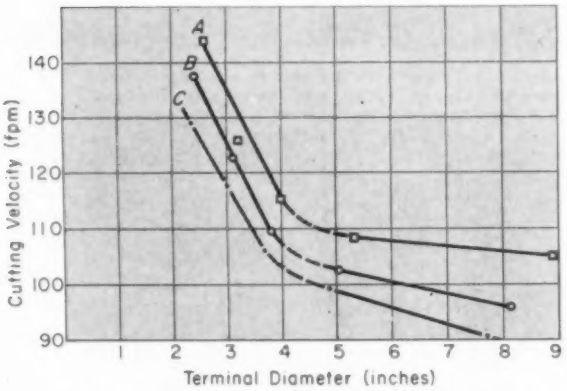

Fig. 2. Plot of tool life as determined by the facing test. *A* and *B* represent tool materials in present use. *C* represents new material.

The compound rest, set at 90 degrees to the cross feed, was fed toward the headstock until the tool contacted the workpiece. The tool was then moved toward the center of the work and the compound rest feed was used to advance it into the $1\frac{7}{8}$-inch hole to provide a depth of facing cut equal to 0.050 inch. The cross feed was set to feed out at 0.012 ipr.

An arbitrary value of 0.002 inch of wear at the end of the tool was chosen as the tool failure point and the diameter of the machined area at the point where the depth of cut had decreased by 0.002 inch was recorded as the terminal diameter.

The cutting edges of tools made of high-speed steel fail abruptly as the terminal velocity is reached. The machine can be stopped when this occurs and the point of 0.002-inch depth decrease can be determined by a dial indicator mounted on the cross feed. Some tool materials, such as cemented carbides, continue to remove metal effectively as the tool end wears away. To save time and tool grinding, a flashlight indicating device shown in *Fig.* 1 is used. This consists of a contact point mounted just behind the tool and set out 0.002 inch from the tool depth. When tool wear decreases the depth of cut by this amount, the light indicates failure.

The tools were tested at several speeds and then again at the same speeds in reverse order. This was done to cancel out the effect of changes in hardness of the cast material as the distance from the cast surface increased. (Differences in tests caused by this change were negligible.) Two tools of each material were tested at each speed. The values presented as the results of tests are the averages of the two tools. In no case was the difference between two readings greater than two percent of the measured distance. After each cut, the unmachined portion of the disk was machined out to the periphery with a carbide tool.

The test showed that the new material will not give three times the tool life of the present material under the same cutting conditions and hence the claims were not substantiated. However, the performances of the tools were close enough together so the significant differences in initial cost would justify analysis by more extensive tool-life tests.

Although the data are not extensive enough to allow definite conclusions, they certainly indicate a change occurring at the "break" in the curve for each of the tool materials tested. A straight-line relationship exists in lower speed ranges, and another different relationship, also a straight line, in upper ranges. The area is between represented by the broken line could not be investigated because of the limited spindle speeds of the engine lathe.

It seems probable that at the higher velocities steady-state heat flow conditions do not exist as they may at the lower velocities so that the machining done prior to terminal velocity in this upper region does not have the same affect as that done at the lower speeds. The questions arising from these curves may form the basis for future investigations.

Applications: Care should be exercised when evaluations of test results are made. The facing test is intended only for primary checks and more research must be done to establish the existence of an accurate correlation with longer, more extensive tool-life tests. In addition to tool life the facing test may be used to determine effects of changes in tool shape, feed and speed.

ROTATION OF AXES

in jig and fixture design

By Robert T. Davies*
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MANY TIMES for convenience in locating parts in jigs and fixtures, it is desirable to rotate the reference line from which parts are dimensioned. As an example, suppose the part shown in *Fig.* 1 is to be placed in a jig using the two large holes for locating. For jig construction purposes, dimensions for the centers of the four smaller holes *A*, *B*, *C*, *D* must be obtained, based on the center line passing through the two large holes. The new part position and required dimensions are shown in *Fig.* 2.

*Senior member ASTE Toledo chapter.

The new dimensions can be calculated easily with simple formulas derived as follows:

Referring to *Fig.* 3, point *P* is dimensioned from the *X* and *Y* axes. To find distances from new axes *X'* and *Y'* with the same origin, but rotated through an angle θ, triangles *PAB* and *OCB* are constructed.

x, y = Original coordinates
x', y' = New coordinates, rotated
θ = Angle of rotation
$y' = PA - DA$
$PA = y \cos \theta$
$DA = CB = x \sin \theta$

Then

$$y' = y \cos \theta - x \sin \theta \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Similarly

$$x' = x \cos \theta + y \sin \theta \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

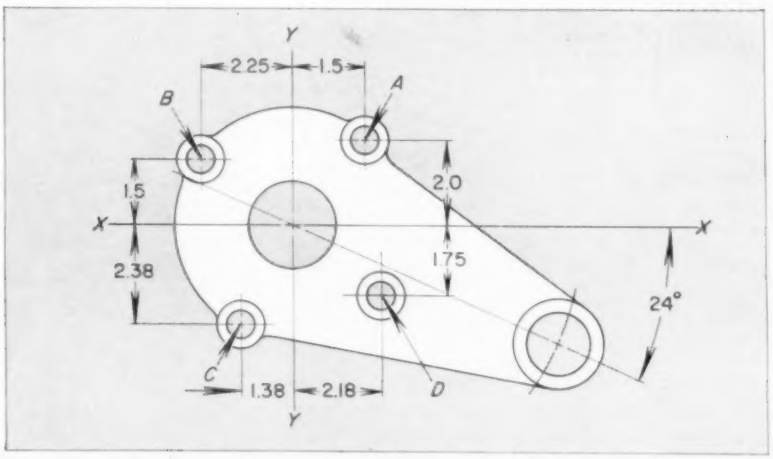


Fig. 1. Sample part to be located in jig by placing two large holes over locating pins.

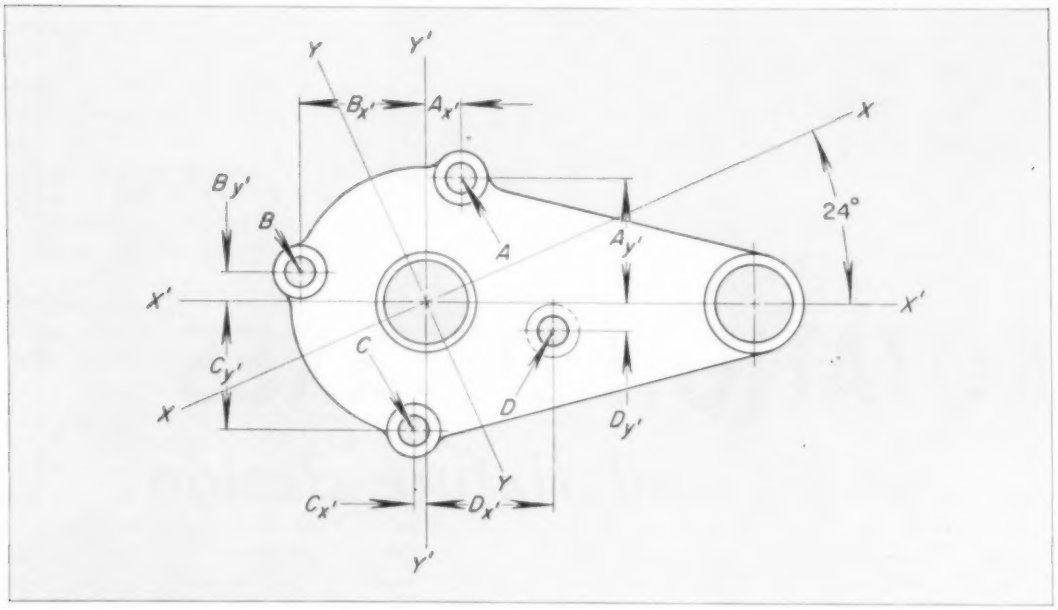


Fig. 2. Sample part showing new dimensions based on center line passing through two large holes.

REFERENCE SHEET

These equations apply if the new axes are rotated counterclockwise from the original. If angle θ is clockwise, then the equations become:

$$y' = y\cos\theta + x\sin\theta \quad \ldots\ldots (3)$$
$$x' = x\cos\theta - y\sin\theta \quad \ldots\ldots (4)$$

In the example in *Figs.* 1 and 2, the new axes X', Y' are rotated clockwise from X and Y, thus; Equations 3 and 4 are used for calculations. Ay' represents the new distance of point A to the X' axis. Other distances of points A, B, C, D are noted similarly.

Given in *Fig.* 1:

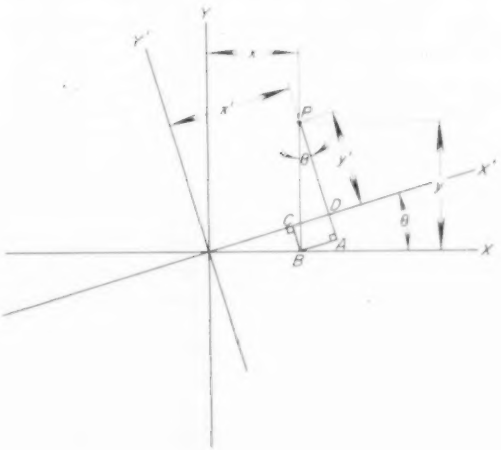
For point A, $x = 1.5$ $y = 2.0$
For point B, $x = 2.25$ $y = 1.5$
For point C, $x = -1.38$ $y = -2.38$
For point D, $x = 2.18$ $y = -1.75$
Sin 24° = 0.40674
Cos 24° = 0.91354

Substituting and solving:

$A_x' = (2.0)\ (0.91354) + (1.5)\ (0.40674) = +2.43719$
$A_x' = (1.5)\ (0.91354) - (2.0)\ (0.40674) = +0.55683$
$B_x' = (1.5)\ (0.91354) + (-2.25)\ (0.40674) = +0.45514$
$B_x' = (-2.25)\ (0.91354) - (1.5)\ (0.40674) = -2.66558$
$C_y' = (-2.38)\ (0.91354) + (-1.38)\ (0.40674) = -2.73553$
$C_x' = (-1.38)\ (0.91354) - (-2.38)\ (0.40674) = -0.29265$
$D_x' = (-1.75)\ (0.91354) + (2.18)\ (0.40674) = -0.71200$
$D_x' = (2.18)\ (0.91354) - (-1.75)\ (0.40674) = +2.70332$

This method reduces the calculations to arithmetic and avoids repeated reference to trigonometric tables and time-consuming interpolation.

Fig. 3. Diagram for deriving equations used to determine dimensions shown in *Fig.* 2.



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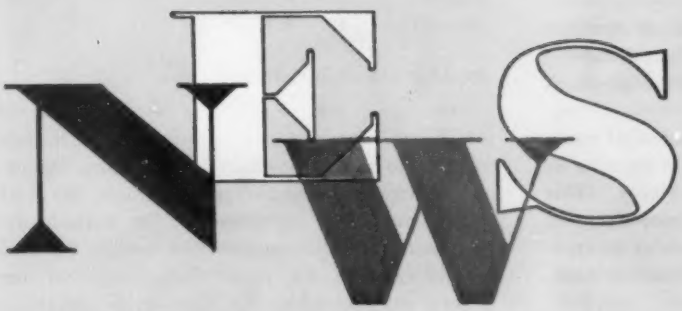


some Vital Statistics on the aste

STATISTICS can be interesting if they're vital. Carefully selected, they can give one a very good idea of the shape of things. With that in mind, here are a few vital statistics on the membership of the American Society of Tool Engineers.

The figures are derived from some purposeful reading of chapter rosters at headquarters, and from an analysis of the circulation of THE TOOL ENGINEER (which includes every ASTE member, of course) by Standard Industrial Classification Groups. The S.I.C. code was developed by the Office of Statistical Standards of the U.S. Government, to promote uniformity and comparability in the presentation of statistical data on the entire range of economic activities.

At last count there were 39,233 paid-up members of ASTE, up more than 100 percent in a decade.

And did you know that these members represent 18,889 plants?

The largest representation, by number of members and by number of plants, is quite logically in the S.I.C. classification called "Machinery." This group includes 38 subdivisions of manufactured products, ranging from monorail systems to typewriters, and taking in 13,539 TOOL ENGINEER readers representing 7475 plants.

Other major divisions of the industrial economy, as far as the ASTE representation is concerned, include:

Electrical machinery facilities, which include household appliances, communications equipment, and the whole vast field of electronics. In this classification, 3407 ASTE members represent 1519 plants across the country.

Primary metal industries, covering steel works, rolling mills, foundries of various sorts, casting and forging operations: 1534 ASTE members in this group represent 836 plants.

Fabricated metal products—nuts and bolts, tubes, springs, cans, cutlery and so on: 3061 TOOL ENGINEER readers representing 1819 plants.

Transportation equipment: 6283 readers representing 2224 plants.

Manpower for the Space Age

Under the transportation category are some statistics that are of special import now because of the current Western Tool Show at Los Angeles with its theme of "Tooling for the Space Age." There are tool engineer members in every major aircraft and missile plant in the United States—a total of 2348, to be exact, which does not include about 1000 more members representing smaller facilities and diversified plants which do some aircraft work.

For some examples: 257 copies of THE TOOL ENGINEER go to people at Boeing, 187 at Douglas, 166 at Convair, 144 at Grumman, 139 at Rohr, 134 at Hughes, 109 at Pratt & Whitney, 103 at Curtiss-Wright, 94 at Aerojet-General, 90 at Northrop, 86 at Martin, 85 at Chance Vought, 72 at Bendix Aviation, 71 at North American, 53 at Fairchild and 52 at Lockheed.

Chapter rosters reveal that these people either have final authority to make decisions on machinery, equipment and tool purchasing, or else they strongly influence those decisions. They may have titles such as production manager, methods engineer, production engineer, manufacturing engineer, works manager, process engineer, and so on—but by and large they are the men who take the blueprints of an airplane or a missile and decide how (and with what machines, equipment, tools and supplies) to make it. In short, they are tool engineers in function if not in title.

An Example of Influence

One major aircraft plant is an illustration of ASTE and TOOL ENGINEER influence: on the Society rosters are the president of the company, the executive vice president, the chief engineer, the chief tool engineer, the supervisor of the methods department, the supervisor of tool design, the tool control engineer, the quality control engineer, the general superintendent and nine other production supervisors, and some 16 people who bear such titles as "process planner," "tool designer"—and yes, even "tool engineer."

That's covering the field.

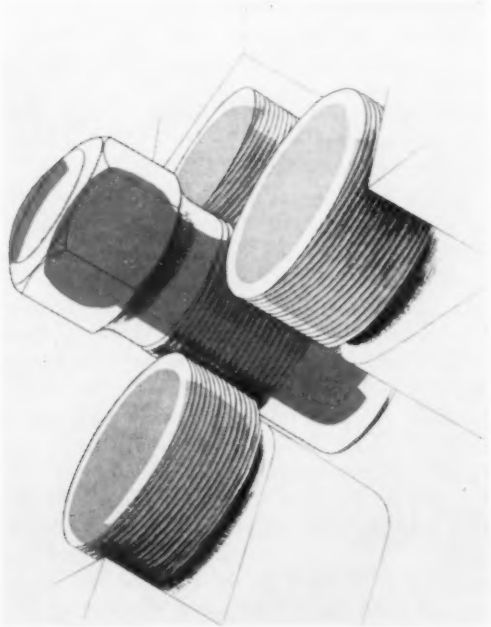
highlights

from the technical sessions

by T. W. Black, senior associate editor

DEDICATED to the theme, "Tooling for the Space Age," technical papers delivered at the ASTE semi-annual meeting maintained the high standards of engineering excellence that have characterized ASTE technical sessions for many years. Although a number of the papers deal specifically with aircraft and missile tooling problems, these problems are similar to those faced by many tool engineers in other industries. As a group, the papers represent a short course in up-to-date technology that will be of great value to tool engineers in almost every industry.

This review is intended to point out some of the more significant developments covered in the papers, and also to indicate the scope of the sessions.



As the design of aircraft, missiles and electronic systems becomes more complex, component fabrication and assembly problems are multiplied. This has resulted in greater emphasis on producibility during the early stages of product design. **C. F. Marschner,** Paper 155, points out complexity is created by product designers and they can also design or redesign for simplicity. Marschner goes on to say that to design for producibility is to purposely control, in the engineering stages, those features of configuration, equipment location, materials utilization and the like which will ensure maximum production rates with minimum deviations from specifications. This approach must be applied as much as possible if time spans from initial concept to an operational missile, for instance, are to be minimized.

Despite special tooling, coupled with training to develop special worker skills, the gap between design and fabrication is widening. Fewer engineers have shop experience and the younger shop personnel do not get the apprentice training that formerly developed highly skilled craftsmen. Additionally, design requirements which, if uncontrolled, tend to create complexity, are increasing too rapidly for tooling or training programs alone to bridge the gap.

Recognizing the need for simplicity, several companies are actively engaged in redesigning products for easier manufacture. No changes in functional requirements are permitted. Such redesign has typically reduced the number of component parts by 75 percent, with accompanying reductions in tooling and fabrication costs and times. Experience has shown that a normal "unproductionized" design will cost twice as much to fabricate as a design developed with production requirements in mind. Several examples are given in the complete paper.

Producibility problems are also illustrated in Paper 156, by **L. G. Granstedt,** who describes tool-

ing for the Atlas missile, and by **A. S. Turner,** Paper 157, who describes the problems involved in tooling for the Snark missile. Fabrication of the missile structure presented no unusual difficulties; however, components for the guidance system required new manufacturing techniques. Tolerances for certain gear sectors were so close that they could not be held on conventional production equipment or measured with the usual instruments. Since functional requirements demanded this extreme accuracy, the producibility problem was solved by developing equipment to do the required work.

Metal-Forming Symposium

Some of the newer aircraft materials have outstanding strength and weight characteristics, but they are most uncooperative so far as forming is concerned, according to **Frank G. Helander,** Paper 165. Forming problems are complicated further by large part sizes and extremely close tolerances. While radically new forming techniques are sometimes considered for such parts, existing forming methods are capable of doing an effective job. Two such methods are high-pressure rubber forming and power roll-forming. Helander describes experimental work with a 6500-ton Loewy Marform press, involving the use of heavy-gage sheet metal, formed to close tolerances. Even larger presses will be required to form major aircraft parts, and the possibility of equipping the Air Force heavy presses (which have capacities of 35,000 and 50,000 tons, and large bed areas) with special Marform package units is being considered. This would permit forming large steel parts. Magnesium and titanium, which require heating during forming, can be Marformed, using heating elements within the blankholder plate. The rubber pads are of a silicone compound.

Power roll-forming equipment is now being utilized for aircraft and missile components but maximum work diameters are limited to 42 inches because of the limited capacity of present equipment. Vertical machines capable of forming parts up to 100 inches in diameter are planned.

New stretch forming machinery is the subject of Paper 166 by **C. E. Blanchard.** Precision cold extrusion technology for high-temperature metals is discussed by **Raymond A. Quadt,** Paper 167. The high-temperature materials discussed are molybdenum, zirconium, zircaloy, titanium, uranium, columbium and alloy steels. Tubes, tube blanks, cups and closed-end tubes can be produced to close tolerances from pure metal. Extrusion of strong alloys of most of these metals has been only partially successful. Increased metal recovery and improved physical properties result from cold extrusion, making the process desirable from cost and quality standpoints.

Tube bending, says **J. E. Hawking,** Paper 168, has advanced from a plumbing art to a science. Practical production bending of eight-inch-diameter stainless steel tubing (0.020-inch wall thickness) has now been accomplished. Center-line radius is 16 inches and wall thinning is only 6½ percent.

A certain amount of wall thinning can be tolerated for most applications. For high-pressure steam boilers, and rocket and missile components, however, wall thinning is undesirable. In a recent development, applicable only when wall thickness is 0.150-inch and up, the compressive side of the tube is heated in the area of bend and a compressive or booster force is applied during bending. Wall thickness of tubes in the 1¼ to 2¾-inch-diameter range can be controlled by this technique.

Keith A. Wilhelm discusses explosive forming of metals in Paper 169. In Paper 170, **Joseph W. Schiffel** describes the use of explosive forming techniques for forming mild and alloy steels. Results have been highly successful in many instances. The tremendous energy available in the explosive charges used would be difficult to duplicate by mechanical or hydraulic means. Peculiarities in the behavior of metals under extremely high energy rates have made it possible to form parts in configurations unobtainable by any other known forming method. The field of explosive forming has not been fully explored. At present, engineers are conducting experiments to determine the formability parameters of many of the common and superstrength materials. An entirely new concept of met-

How to Obtain Papers

Recognizing the possible permanent value of the technical papers presented at the Los Angeles Semi-annual Convention, the ASTE program committee has made them available in printed form.

Copies of the papers can be obtained from Society Headquarters, 10700 Puritan Avenue, Detroit 38, Mich. Cost of individual papers to ASTE members is 50 cents each; to nonmembers, $1. Collected papers of the convention—bound as Volume 58, Book II—run $5 for members, $10 for nonmembers.

al fabrication will perhaps result from this work.

Power roll-forming applications are covered by **John N. Heater,** Paper 171, who also describes the metallurgical improvements in the workpiece resulting from the process. Current work centers around forming hemispherical shapes and venturi nozzles. Development of a machine for power roll-forming titanium hemispheres is detailed by **Fred Spiegl,** Paper 173. Close control of rolling forces is particularly important when forming titanium because of the small gap between the ultimate and yield strengths of the material. The material is heated for forming. Power roll-forming is also the subject of a paper by **Claus Sporck** and **William H. Busch,** Paper 172. Tooling costs for the process are considerably less than the costs for deep drawing, since a simple shaped mandrel takes the place of dies.

Alfred G. Jones, Paper 174, tells how heat-treatable titanium alloys, steel alloys and hot-work die steels are being formed to close tolerances by precision forging. This process, like power roll-forming, eliminates or greatly reduces the amount of metal that must be reduced to chips in shaping a part. Compressor blades and turbine buckets are typical parts that are being precision forged. Precision forgings are much higher in cost than conventional forgings, owing to higher die costs. A conventional die for one forged part cost $1450; a precision die for the same part cost $14,000.

In Paper 175, **H. E. Haley** outlines fabricating techniques for superalloys. After discussing welding, heat treatment and descaling in full detail, he describes forging methods employed for superalloys. No unusual difficulties are encountered with these relatively formidable materials, provided that billet temperatures are carefully controlled.

Metal Removal Symposium

Recent progress in cutting tool materials is described by **Paul A. Kafader, Jr.,** Paper 162. New grades of carbides are capable of cutting hard materials at high rates of speed. Best results are obtained when the tools are mechanically fastened to the holder, because of stresses induced when brazing tools to steel shanks. Negative rake angles are recommended. The cutting forces on a positive rake tool are applied in such a way as to load the carbide in shear, at least in part. The lack of shank support under the carbide opposite the normal cutting force is conducive to premature breakage.

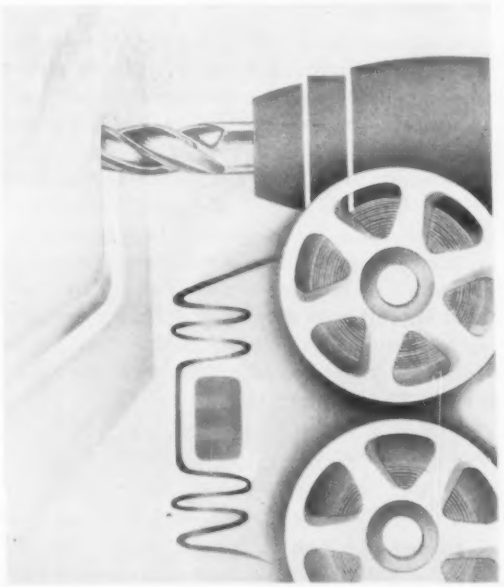
With a negative-rake tool, on the other hand, normal cutting forces are transferred through the carbide to the supporting shank, so that reaction on the part of the shank opposite the force loads the carbide in compression. The compressive strength of carbides is of a high order and there is no danger of failure because of compressive loads.

Advanced rocket materials can be broadly classified into metallics and nonmetallics, according to **J. A. Mueller,** Paper 138. The metallics include zirconium, molybdenum and sprayed coatings known as "self-fluxing" alloys, which contain boron and silicon. Nonmetallics include dense silicon carbide, dense high-purity alumina, the borides and carbides of zirconium and titanium, and flame-sprayed coatings of both alumina and phenolic-impregnated alumina. These are sometimes called refractory hard materials. Rocket materials can be machined by grinding. Wheel specifications, coolants and other pertinent specifications are given in the paper.

New milling techniques are outlined by **A. O. Schmidt,** Paper 139. After reviewing the theoretical grounds for the belief that cutting temperatures go down after some "superhigh" cutting speed is reached, Dr. Schmidt concludes that the greatest advances in machining techniques will come as a result of research along conventional lines, rather than through "explosive machining" where the workpiece or tool is actuated by a powder charge.

Mechanical cutting methods may not be the most satisfactory method for cutting the tough materials now being used in airframe and missile construction. Slow machining speeds and rapid deterioration of cutting tools are only two of the major problems involved in cutting these materials, as pointed out by **Lynn A. Williams,** Paper 140. Other problems are heavy burrs, loss of important properties from cold working, and thermal metallurgical damage. Solutions have ranged from minor improvements in machining practices, speeds and feeds, and improved cutting tools, to "explosive machining."

Three relatively new methods avoid most of the



difficulties associated with mechanical cutting methods. These are spark-arc disintegration (Method X and Elox), chemical milling and electrolytic machining (Anocut). The latter process has recently been improved so that holes of irregular shape can be cut into various steels and superalloys at rates from 0.004 inch to 0.007 inch per second. A cavity one inch deep can be sunk into hardened tool bit material in about three minutes—a speed as fast or faster than conventional drilling. With a sufficient number of electrodes, large areas can be machined with high metal-removal rates.

Machining properties of several high-strength materials are discussed in Paper 142, by **Norman Zlatin** and **Leonard J. Nowikowski.** Included are S-816, Inconel X, A-286, SAE 4340 steel, stainless steel at strength levels above 250,000 psi, titanium alloys such as the heat-treatable 6A1-4V alloys, and molybdenum. Data is based on tool life tests in turning.

Cutting fluids are covered by **A. W. Ackerman,** Paper 141. The topic of Paper 143, by **C. A. Wallace,** is industrial filtration in the metalworking industry. The equipment available includes flotation type clarifiers, pressure filters, cartridge type filters, vacuum and gravity paper belt type filters and magnetic separators. Cost and performance factors are discussed, with examples of actual installations.

Experiments with "explosive machining" at Lockheed are described by **Robert L. Vaughn,** Paper 164. Current tests have been conducted at speeds up to 180,000 fpm, firing a steel slug so that it grazes a cutting tool. In all tests, a definite cutting action has been observed. Tools do not fail and surface finishes are as fine as 15 microinches. No chips are found at these high speeds. Tests now being planned will be at cutting speeds up to 360,000 fpm.

Machining of high-tensile materials is the subject of Paper 144 by **Roger W. Runyan.** Performance characteristics of ceramic tools in turning and milling are reviewed by **E. J. Krabacher,** Paper 145.

In a talk on abrasive-belt machining, Paper 146, **John M. Pitblado** shows how operating variables can be controlled to give improved belt life. Tooling for sculptured structures is the topic selected by **Fred E. Pauls,** Paper 163.

Chemical Milling

In 1953, the first mass-produced chemically milled parts appeared on an aircraft assembly line. As discussed by **Lew B. Stearns,** Paper 148, the success of that application opened the way to hundreds of similar applications where excess weight is removed from skin sections after heat treating. Neither the contours of the parts nor the physical properties of the parts are changed by the process. On the Convair B58, a weight saving of 600 pounds was realized on the wings alone. Other applications are described in the paper.

Chemical milling also has tooling applications, as pointed out by **George E. Larsen,** Paper 147. Matched dies can be made by making the punch to the die dimensions, casting a plastic die directly to the punch, then chemically milling the punch to give the required clearance for the thickness of the product. Tooling for chemical milling consists mostly of templates and various types of templates are described. Other methods of establishing the pattern of the area to be etched, such as silk screening and photosensitive coatings, are also described. The latter two methods are not considered practical for most types of work.

New Materials

Beryllium is a metal of great interest to the designer of air and space craft. Its desirable characteristics, as listed by **K. G. Wikle,** Paper 176, are lightness equal to that of magnesium alloys, a stiffness 50 percent greater than that of steel, a useful structural range above the melting points of aluminum and magnesium, excellent thermal and electrical conductivity, and high heat capacity. The metal has not been extensively used in the past because of lack of availability and inadequate development of fabrication technology. Dr. Wikle describes all pertinent material properties and gives data on machining, forming and joining.

With the rise in airframe operating temperatures, Inconel X is being more frequently applied. It has good impact and notch strength even at —320 F and it is superior in strength to most commercial alloys in the 900-1400 F temperature range. **R. R. Ferguson,** Paper 178, shows how this material is heat-treated, welded, machined and formed. Fabrication of refractory metals is covered by **William L. Bruckart,** Paper 177.

Tooling for Electronics

William C. Leone, Paper 136, shows how fully automatic production is possible through electronics. As Leone points out, there are three general categories of automation systems in use. The first is the Detroit type transfer line, which has a multiplicity of machines connected together to cycle through a set of specific operations on a particular part. Second is the tape-controlled contouring machine. A third category represents a combination of the best features of transfer lines and numerically controlled machines. This is the integrated line of numerically controlled machines which incorporates numerically controlled transfer of parts from sta-

tion to station. Characteristics and operation of the Hughes system—the first in this field—are described in detail.

The science of electronics has contributed greatly toward lower-cost manufacture; the science of tool engineering has contributed greatly toward the efficient manufacture of electronic devices. Many of these devices contain components that require the development of entirely new production techniques. **R. N. Marshall,** Paper 181, shows how effective cooperation between tool engineers and management helped to bridge the gap between the design and production of wave guides. There is comprehensive treatment of wave guide production in the paper. Tooling for semiconductors is covered by **Elmo E. Maiden,** Paper 137.

Producing electronic and other components for missiles designed for space flight calls for creative tool engineering of a high order, as pointed out by **T. F. Vajda,** Paper 183. Deviation from blue-print tolerances cannot be tolerated, so tooling must be good. At the same time, production costs must be held down. One solution described by Vajda is "erector set tooling"—jigs and fixtures made up from standard components. Such tooling provides the necessary dimensional control, yet it can be quickly assembled and is much more economical than special tooling. Numerous examples are given.

Quality Control

"Egg-crate sampling" is the name given to the quality control method described by **William R. Baker,** Paper 179. The name "egg crate" is derived from the special racks used to deliver parts to machine operators in Baker's plant. Each part is numbered and is placed in its own individual nest in the rack. Initial inspection is performed on a sampling basis by machine operators. Quality defects are quickly noted and the operator can make any necessary corrections immediately.

Numerical Control

There are many different numerical control systems in use for contour milling and similar operations. Most of these systems are not "compatible"—that is, they are designed for different varieties of punched cards, which may have machine control information recorded in various ways. No agreement has been reached on standardization; the makers of each control system feel that they have the best type of input tapes.

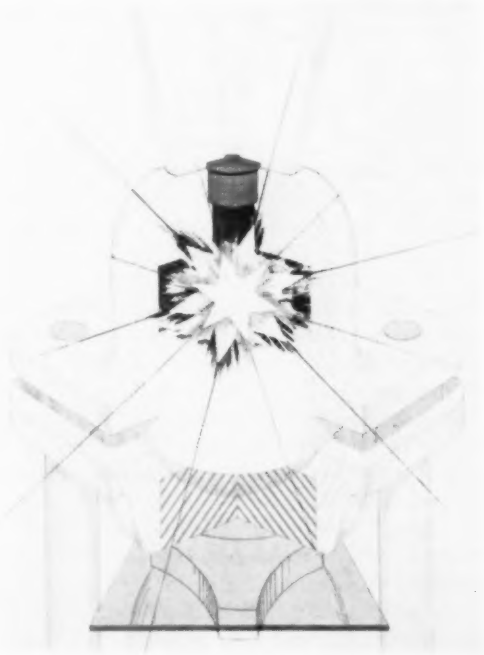
According to **E. F. Carlberg,** Paper 134, compatibility is no longer a problem. A computer program for numerical control has three fundamental parts: a translator that converts human input (words, numbers, symbols) into computer language; an arithmetic unit that figures the geometry; and a post processor, which takes the detailed X, Y and Z cutter path and puts it into the language of the machine tool. Up to the post processor, the machine tool or control system used is not a factor. Thus post processors can be written for each system and, by throwing a switch in the computer, any desired output tape can be produced. In this way, compatibility problems are easily solved.

David E. Laughlin, Paper 135, outlines the features that should be incorporated in point-positioning or contouring numerical control systems and points to the need for systems builders to work closely with users in order to develop equipment that fills current and future needs. The scope of numerical control systems is explained by **Bernard Gaiennié** in an unnumbered paper.

Optical Tooling

For a number of years, optical tooling has been applied to airframe manufacture, where it has become a standard alignment checking method. Today, such tooling is being widely applied to other types of work. Three different methods are described by **W. L. Egy,** Paper 161. These are: Layout on large workpieces where other methods are somewhat awkward; inspection where many key points must be measured in three dimensions and time is important; and location of points where direct sight is blocked and some mathematics is needed to obtain a solution.

A typical example of the first method is layout of a 20-ton casting (a turbine ring) to an accuracy of 0.002 inch. Inspection of an automobile body-



highlights

in-white and triangulation on partially hidden points are also explained by the author in some detail. One interesting application is the use of optical tooling to take measurements on two-ton red-hot forgings that could not be checked in any other way.

K. H. Boucher, Paper 182, covers closed-circuit television as an aid to optical tooling. The television camera is focused at the eyepiece of the microalignment telescope and the target image appears on a television receiver close to the work position, eliminating the need for an observer at the eyepiece of the telescope. The jig builder observes his own adjustments. This eliminates often confusing hand signals. Since the image seen on the television screen is greatly enlarged, the accuracy of imposing the target image over the cross-hair reticle is improved.

Recent developments in the use of optics as an engineering tool are discussed by **A. W. Young,** Paper 160. Young describes all modern optical checking instruments, including autocollimators and theodolites.

Welding and Joining

Welding tooling for missiles is the subject of Paper 149 by **Byron Russell.** In Paper 151, **Gerald Garfield** covers tooling for welded aircraft and missile pressure vessels. Forming methods for hemispheres and cylinders are covered in detail, as are welding methods and fixtures.

Ultrasonic welding is rapidly becoming a useful tool for industry, according to **J. Byron Jones** and **W. C. Potthoff,** Paper 152. The authors describe single-spot, overlapping-spot and seam welding methods. Advantages of the process are absence of heating; ability to join dissimilar materials and ability to weld thin materials to thick materials. Numerous production applications are described and details of welding tip configurations for various applications are illustrated.

High-temperature brazing techniques for joining honeycomb sandwich constructions at 2000 F are discussed by **F. J. Filippi,** Paper 132. Operations of this kind are performed in inert-gas atmospheres or in vacuum to eliminate corrosion. Fixture and retort design are covered. Construction methods for multicurved honeycomb sandwich are illustrated by **Edward Carmichael,** Paper 133.

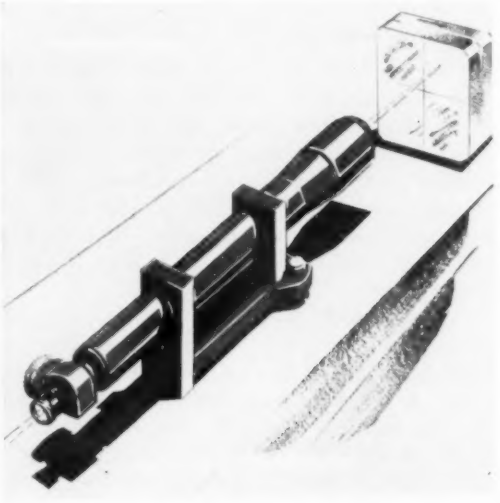
As pointed out by **C. E. Johnson, Sr.,** Paper 153, the cost-per-pound of airframes has steadily risen with increased speeds. Continuous tool research and development are a necessity. Various construction methods now being contemplated by designers are illustrated in the paper.

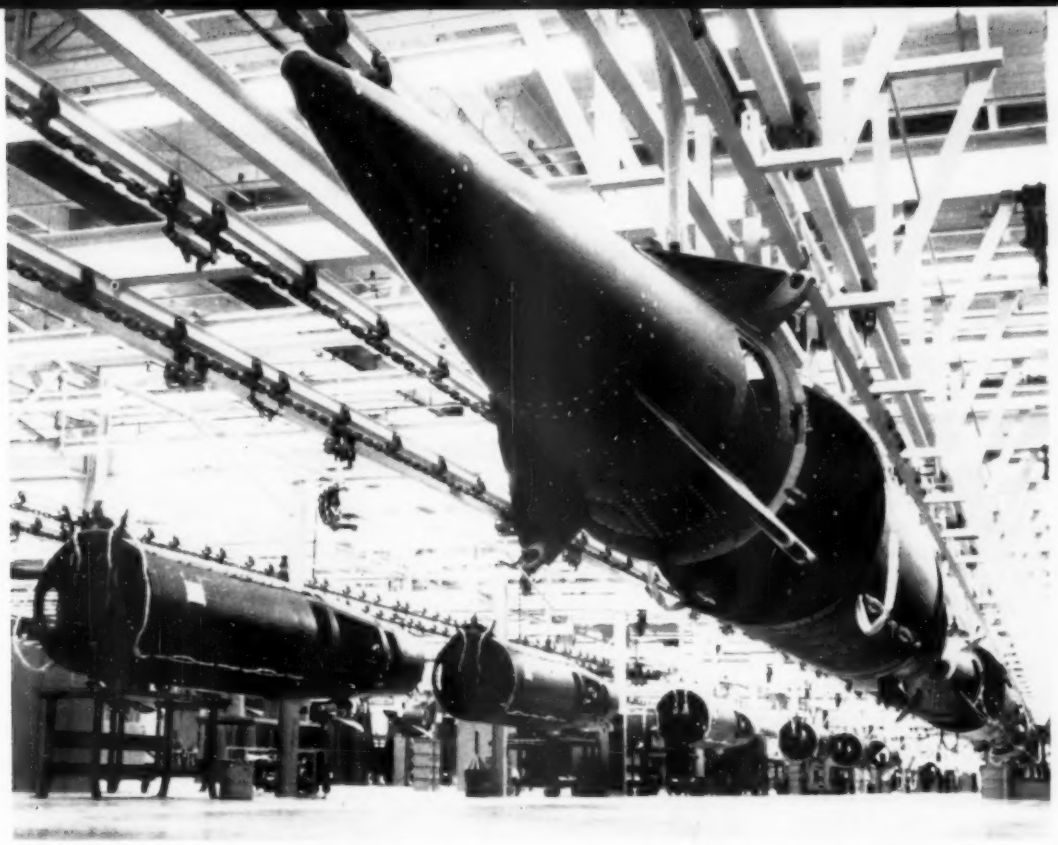
Airframe engineers are trying to develop structures for the space age. Such structures must be designed with rigorous strength-weight ratios in mind, plus resistance to heating at extremely high speeds. Solutions to these requirements are monocoque, shingle and sandwich construction, with refrigeration, insulation and coating of areas exposed to high temperatures. High-density refractory materials will be used in these structures, as well as precision forgings, castings and pressings. In addition, alignment and accuracy of assemblies and the methods of joining details and assemblies will be improved. The tool engineer must keep pace by rapidly developing tooling techniques, methods, processes and equipment to produce the required product. At the same time, production costs must be kept down.

Tool planning for modern missiles is the subject of Paper 154, by **A. H. Dunn.** Tooling for the space age is covered by **J. H. Lewis,** Paper 186.

Education

New frontiers in engineering education is the topic of Paper 185, by **Morris Asimow.** A curriculum for college engineering students is described. **Jack Kadushin,** Paper 184, discusses tools for the tool engineer. These "tools" are the skill and knowledge required to perform the tool engineering function. First of these is ability to communicate his ideas. Second is knowledge of materials. Third is an understanding of modern manufacturing methods. Fourth is an understanding of basic physical phenomena. A final requirement is the ability to use mathematics.





Rapidly nosing up among industrial leaders—"king" cotton, tobacco and lumber—in North Carolina's economy is the missile business. Here the Nike Hercules moves through the final assembly line at Douglas Aircraft's 10-acre plant in Charlotte. Southern workers are as easily trained in the latest light metal fabication techniques as they were at the loom and spindle half a century ago.

Piedmont on the Move

by **Suzanne Olson**, associate news editor

"EVERYTHING'S ON THE MOVE in North Carolina." boasts a popular slogan in the Tar Heel state. The words aptly portray the industrial scene, the activity in the Capitol, and the genuine aura of optimism (backed by convincing figures and an all-out selling campaign) on the part of local chambers of commerce.

In a period referred to nationally as a "rolling adjustment" by the cautious, and as a regression, recession or depression by varying shades of realists, the industrial expansion, dollar output, and employment figures never looked better in North Carolina. For the first time in the state's history the output of its 7000 manufacturing plants exceeded the $7 billion mark in 1957. Among the states listed in the Blue Book of Southern Progress, this figure is second only to that of Texas, whose 9000 plants produced $13.5 billion worth of goods.

Characterizing the flurry of activity is the statewide concern about economic conditions. Everyone is interested, anxious, eager to help—from the businessman-turned-governor, Luther Hodges (who has more schemes to entice businesses to his state than R. J. Reynolds has Camels—almost) to the colored woman who, interrupted from her routine duties to help the president of the mill lay out some sweaters, seized the golden opportunity to ask, "How we doin', boss? We makin' any money?"

Eighty-seven years ago another period of economic change jolted haystack snoozers out of their complacency. Governor J. Jarvis' inaugural address in 1871 sounded the notes of the first industrial revolution: "The Commonwealth moves with a quicker life than formerly. The genius of the former state of things was repose; that of the present is activity."

Last year Governor Hodges, taking the pulse of the people, reported in much the same tone, "I sense a new feeling, a new determination in North Carolina, to expand, to grow, to give our people a fuller life." Thus the new industrial revolution, brought into being by modern science and technol-

ogy, is infecting the people with a highly contagious case of constructive energy.

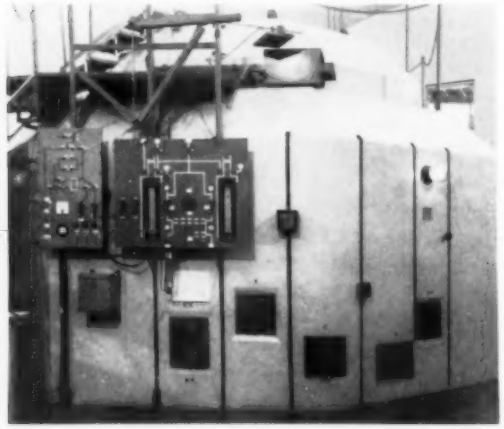
* * *

What of the intervening years? Industry came to the state, but developed along stringent lines, paralleling the main agricultural products. The lopsided economy, built on cotton and tobacco—and later on furniture from native lumber—netted North Carolina the title of number one industrial state in the Southeast.

But what's in a name? The majority of the population either remained rooted to the soil, dependent on the low-income-producing tobacco and cotton crops, or worked at poor-paying jobs in the mills and factories that utilized these materials. And the state slipped to 48th in per capita income. The more ambitious citizens moved out of the state for more lucrative employment.

As it did elsewhere, wartime wrought some changes. The cry for defense materials and more civilian goods opened the door for new industries. Metal products, paper, chemicals, electrical instruments and equipment got a foothold. War-born of necessity, and nourished by a hungry populace and a solicitous government, postwar expansion continued at an ever-accelerating speed. Though the "big three" of furniture, textiles and tobacco still lead the list in value of manufactured products, each year sees greater inroads being made by an increasing variety of other industries.

In 1955, electronic concerns led the expansion parade by investing $26 million in new or expanded facilities. Employment in this field rose astonishingly from 66 workers in 1940 to an estimated 25,500 when current expansions are completed.



North Carolina State College's nuclear reactor is first college-owned facility of its kind to be constructed for peacetime development of the atom. It represents but one industrial attraction of the Research Triangle.

Paper plants took the lead in '56, investing $43 million in increased facilities, while metal-working surged ahead a year later. The biennial report of the Department of Conservation and Development's commerce and industry division shows the two-year fiscal period ending June 30 of this year broke all state records in amounts of new and expanded plant investments; the biggest factor was the $149.4 million worth of expansions in the metalworking classification of industry during that period.

* * *

The topography of North Carolina divides it into three parts: the mountain, the mid-state Piedmont, and the coastal regions. The Piedmont is both more populous and more productive than the other parts. Sixty-five percent of the new plants built in the state last year were located in the Piedmont "industrial crescent," an arc-like region curving northward and eastward from Charlotte, near the southern border, through Kannapolis, Winston-Salem, High Point and Greensboro, to Chapel Hill, Durham and Raleigh.

A tour of this "crescent" shows the stamp of the space age superimposed on the home-grown industries. Missile body fabrication at Douglas Aircraft's Charlotte plant; missile guidance components at Western Electric in Winston-Salem; special self-activating batteries for use in planes and missiles at American Machine and Foundry in Raleigh; printed circuits here; digital computers there; complex electronic devices, and simple but accurately formed metal parts for radar systems and rocketry. . . . Such examples of modern technology are demanding new skills—and providing better wages—for native labor, which has proved itself both receptive to training and highly productive.

Modern methods and precision engineering are not restricted to defense projects and the missile, electronic and related fields. A kaleidoscopic assortment of goods flows from the state's multi-million dollar plants as well as its small job shops.

Ingenuity is often evident, as it was in the "home-made" automatic shearing machine that Fred Butler demonstrated at Pneumafil Corp. in Charlotte. Pneumafil, which has no product of its own, makes everything from automatic dispensers for packaged ice cream to small machined parts of plastic and aluminum—materials requiring special treatment.

Ingenuity accounts for the nylon-faced plunger that packs pipe tobacco into cans, nylon being the only feasible material to which sticky additives such as tar, honey and licorice don't adhere. Ingenuity was responsible for the toothed metal rods, made by Dixie Machine Co. in Greensboro for textile mills, on which man-made fur fabrics are wrapped to keep them from crushing in shipment. An ingenious mind developed methods to utilize the waste tobacco dust from cigarette manufacture.

The variety of metalworking techniques that a factory snooper in North Carolina would see is almost endless. At Truitt Mfg. Co. in Greensboro, huge room-size pipe sections destined for Duke Power and Light were being roll-formed from sheet steel and welded together. Hobbing and grinding small lots of precision gears to extremely close tolerances was a specialty with both Western Electric in Greensboro and Zagora Machine and Gear in Charlotte. (Ed Miller at Western Electric says, "If a gear's tough to make, we make it," while Ed Zagora admits accepting orders for some gears even the larger company won't tackle). Bulge forming, done with tremendous air pressures, was among the latest techniques Douglas used in shaping aluminum for certain sections of the Hercules missiles. And so it goes.

* * *

Far from the thumping presses and screaming drills, yet not so far removed as you might think, Governor Luther Hodges sits behind his massive desk in the Capitol hatching schemes to attract "the right kind" of new industry to the state. Behind his deceptive dimples and roguish look is the keen mind that carried him from mill hand and office boy with Fieldcrest Mills, a Field subsidiary, to the vice presidency of Marshall Field. Schooled in the efficiency of the business world, he has sought to run state business the same way—economically, efficiently, and competitively.

Two of the governor's choice devices for convincing businesses to locate in his state are the Research Triangle concept and the revised tax structure. At his prodding, the legislature lopped corporation taxes some $7 million a year by a more equitable apportioning of the tax burden.

Of his tax cuts, Governor Hodges said, twinkling eyes belying his words, "That's something only a crazy governor would do—try to lose $7 million for two years running." Then, leaning forward, obviously enjoying the joke, he continued, "You know, we only lost two million the first year." The reason? The day the bill passed, the newly organized Allied Kennecott Titanium Corp. decided on North Carolina over two other states for its new $35 million plant, and later, R. J. Reynolds decided to pour a similar amount into a new cigarette plant in Winston-Salem.

Pet project of the state's number one salesman is the Research Triangle. The hundred-square-mile area, bounded by the three campuses of North Carolina State College in Raleigh, Duke University at Durham, and the University of North Carolina at Chapel Hill, constitutes for industrial purposes a single campus, representing an outstanding concentration of academic and scientific knowledge.

The 2000 faculty members of the three schools, a combined library of 2 million volumes, and such added attractions as the nuclear reactor at State College, and the Institute of Statistics, located partly on both the Raleigh and Chapel Hill campuses, are indeed enticements. Add to this the opportunity for a whack at some 1200 graduates each year, many of whom seek employment out of the state but would welcome a chance to stay at home, and you begin to see the potency of His Excellency's "secret weapon," the Research Triangle.

Development plans call for a 4000-acre landscaped industrial park, made highly accessible by three railroads, a superhighway, and an airport from which one-hour commuting to Washington is possible. First company to jump at the proffered scientific goodies was Astra, Inc., a small nuclear engineering firm in Milford, Conn., which would benefit immeasurably from proximity to the nuclear research facilities of the Triangle.

Chapter on the Move

WHEREVER there's industry, there are tool engineers and, of course it follows, ASTE members. With industry "on the move" in North Carolina, and especially in the Piedmont area, what of the Society's Piedmont chapter, which serves this area?

". . . One of the most progressive and live-wire chapters I've visited . . . Does things on a grand scale . . . Its activities and accomplishments could well serve as a model for some of our less progressive chapters."

These words, penned by National Director Frank Ford after he officiated at the Piedmont installation ceremonies last March, decided THE TOOL ENGINEER that a personal investigation was in order. A trip to the area revealed that the chapter, its members, and its outlook were indeed different—and dynamic—just as the area that supports it.

A typical example of the group's vitality came in the person of one of Piedmont's past chairmen, Sidney B. Jeffreys. This lanky six-footer managed to exude a bubbling enthusiasm for his chapter and the Society, maintain his aplomb amid jibes about his "time-clock" efficiency and zealous planning, and still epitomize the typical southern gentleman, with easy drawl and gallant manners. One wonders how anyone could talk so slow yet move so fast.

Sid had chairmanned the chapter's 1956 on-Campus Conference at North Carolina State Col-

lege, and had turned in a winner, due in large measure to his detailed planning. A glance at the list of names on the nine-page schedule of meetings, visits and plant tours, which he had drawn up for this reporter, served as proof that he had more than a nodding acquaintance with the Piedmont's industrial, governmental and educational activities and leaders, from the governor on down.

Back in 1952, when the group was but three years old, it was already recognized as a vital force in the move toward improvement of technical education in the state. One full page of the *Winston-Salem Journal and Sentinel* of that year described the chapter's endeavors to remedy the all-too-apparent lag between the personnel needs of the region's spurting industrial growth and currently available training programs.

Typical of the individual responsiveness in the group, Western Electric engineers Jack Schiller and Al Fairchild made a detailed study of what it would take, in terms of space, money and machine tools, to establish an adequate technical institute in Winston-Salem, and submitted their findings to the state board of education.

The problem of training the area's available youth for today's even greater influx of industry is still a challenge, and one that is still being met —more than half-way—by Piedmont members. When plans for seven new technical training centers in Piedmont were still in the talking stage, the chapter offered immediate support of the idea, volunteering its combined technical know-how in designing the machine shop for the first of the schools to be opened this fall in Jamestown, N. C. The tool engineers' continued advice and support of the Jamestown school and the others to follow show the chapter's awareness of its obligation to industry, and its willingness to do its part.

* * *

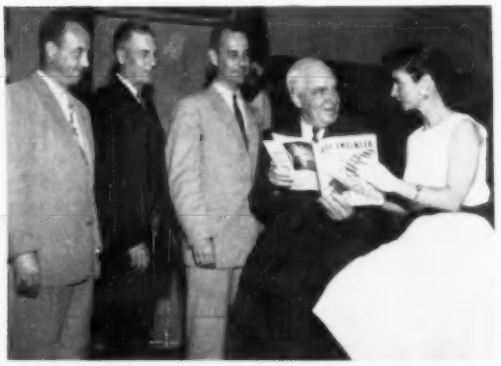
Piedmont's vitality is also evident in its fostering of subchapters. Under its sponsorship, the Raleigh-Durham chapter was chartered in June of 1956, and at present, subgroups at Bristol, Tenn., and Greenville, S. C., are being groomed for independent status. In the last year, Piedmont also doubled the service to its own members, booking technical speakers two consecutive nights to accommodate residents of both northern and southern areas. Chairman Ed Zagora is quick to point out that Piedmont is still but one large chapter, despite the two meeting nights.

An effective instrument for tying the chapter together has been the chapter bulletin, the *Piedmont Tool Engineer*. Almost from the chapter's inception, the bulletin has been not only an important source of revenue but an active voice in carrying the objectives of the Society, news of the local chapter, and technical data to chapter members, prospective members, and top management people throughout the whole "crescent." It undoubtedly has had its effect in attracting the unusually high percentage of top-level titles in the membership roster—plant managers, company presidents, college deans and the like.

The strength in this far-flung chapter lies partly in the fact that, from the very beginning, a concerted effort has been made to keep any one company or area faction from dominating it. Jack Schiller and Al Moosbrugger, two of the Piedmont pioneers, tell how the nucleus of tool engineers from Western Electric considered it unwise to try to organize a chapter out of representatives from just the one company, and thus took their time in this effort, making sure that other areas and companies were represented.

Neil Dietler, another early chairman, phrased the operating philosophy which is still being used by current chapter executives in these words—"We never tried to do things the easy way." Indeed it would be difficult to do things the easy way, when the area supporting chapter membership is 40 percent larger than all of New England.

Perhaps the greatest contribution to the success of the Piedmont chapter is the natural friendliness and spirit of cooperation with which the natives are blessed, and which seems to rub off on newcomers to the area. A Golden Rule sort of courtesy, along with a finely developed sense of humor among the members and officers, who enjoy kidding themselves as much as each other, has helped to weld the unit into a chapter definitely "on the move."



Governor Luther H. Hodges checks *The Tool Engineer's* July issue story on nearby Florida, friendly industrial rival, with visiting editor, Suzanne Olson. Accompanying her is an informal delegation of Society members comprised of (from left) Raleigh-Durham chapter executives, Jack Reilly and Larry Gill of Westinghouse Electric; and Piedmont Past Chairman Sid Jeffreys, owner, Jeffreys Engineering.

engineers take students beyond textbooks

by **Albert R. Fairchild***

Metallurgist
Western Electric Co.
Winston-Salem, N. C.

ANY ENGINEER in the Winston-Salem, N. C., area is liable to get a call, at most any time, that runs something like this:

"One of my boys in the Junior Engineers Club at our school has a problem. He needs help on such-and-such a subject, and we figure you're the man that could give it. What do you say?"

If any engineer in the Winston-Salem area should say no, he would be the first one to do so in the three-year history of a remarkable liaison between engineers and hundreds of potential engineers and scientists.

Since 1955—even before the challenge of the Sputnik era—the Winston-Salem Engineers Club has sponsored 11 Junior Engineers Clubs within both the city and the Forsyth County school systems. At the present level of membership, our liaison engineers are in direct contact with over 500 enthusiastic students.

The program had its inception in days when the public and the press were worrying over the shortage of engineers to meet the looming challenge of the Communist world. Now that the space race is on in dead earnest, the hue and cry is no longer so much for quantity. The main concern now is for the quality of our engineering students and of our high school curricula.

We think that our clubs program is helping to solve problems of both quantity and quality—it is luring more and more talented students into mathematics and the sciences, and it is offering an outlet for their creative thinking.

This story of our project is offered for the benefit of other localized engineering organizations, such as ASTE chapters, who might wish to sponsor similar movements. It is a summary of group experiences; necessarily omitted are the personal experiences, the tremendous personal satisfactions, that have been derived by participating engineers.

All it takes to start a Junior Engineers Club, we've found, is one student with a desire to go beyond the textbook, one teacher with the willingness to go beyond the call of duty, and one engineer with vision and social consciousness.

In the fall of 1955, C. W. Reynolds, assistant works manager, staff engineering, N. C. Works, Western Electric Co., called a meeting of industrial engineering chiefs, educators, and engineering society presidents to discuss local high school education. The discussion boiled down to the following conclusions:

- There is a need to interest more students in math and science
- Teachers need greater income
- Teachers need to understand better industry's personnel needs
- There is a need for better qualified teachers of math and science.

Unanimously recognizing the necessity of turning out more engineering and science-minded students with a well-rounded, scientifically based high school education, the group concluded that:

- Something could be done
- Business could not lead but would wholeheartedly support
- Local education could and would follow but needed a great deal of help
- An impartial, local interested organization must provide the impetus and the basic organization.

The Winston-Salem Engineers Club accepted the challenge. It set up a new committee with the definite assignment to establish a Junior Engineers Club in one city school and one county school as soon as possible; to plan for at least one joint meeting of junior and senior clubs; and to establish a plan for summer employment of math and science teachers.

The engineers have done just that. The clubs program is working and is accomplishing much that is good. Local business has backed us all the way, and both school systems are fulfilling their obligations.

Our community is outstanding in the proportion of resident engineers. The population of Forsyth County is about 175,000. Of this number, over 1000 are engineers, many of whom are employed at the R. J. Reynolds Tobacco Co. or Western Elec-

*Vice chairman of ASTE National Professional Engineering Committee

tric. There are a dozen engineering societies with chapters in our area of the state.

Fortunately, about 200 of the 1000 also are members of the Winston-Salem Engineers Club. We have in the past year placed our Junior Engineers Club committee of 25 men under the education committee, and have selected men for the over-all committee in a manner to have representation from each of the engineering societies. These men are able to keep their society abreast of our educational efforts and, in addition, form a ready contact for our school clubs to call on their society for specialized programs or speakers.

The committee does not hesitate to ask any engineer for help, whether he is a member of the Winston-Salem Engineers Club or not. We have yet to be refused.

The only change contemplated in committee structure for the coming year is to assign a second liaison engineer to each club. With the travel requirements of our own jobs, we have found that frequently we were unavailable to our assigned club when needed. Besides increasing the possibilities of assisting our clubs, we have realized the need to bring "fresh blood" into our movement.

Each Club Is Autonomous

Naturally, we have established some policies over the years. These policies are elastic and subject to change with changing conditions. In brief they are:

1. Each junior club is autonomous. It establishes its own name, rules, and membership requirements. We suggest the name—Junior Engineers and Science Club. We may recommend the rules, aims, organization, and membership requirements.

A salutary example of a Junior Engineers Club constitution is the one drawn up at Greensboro Senior High School. The club defines itself as "an active organization of science students engaged in the search for new facts and ideas relating to scientific principles and their application." It aims "to provide a means for developing basic research in projects which are not usually a part of classroom activity; and to stimulate through active participation and demonstration of perfected projects an enthusiastic approach to future study of science as a career." Any science student "with an interest in creative project work" may enroll. Then when he successfully demonstrates before the club the completion of a "do something" project, he can become a Junior Engineer.

2. There shall be as few committee meetings as possible. To date, the Junior Engineers committee has met only once at the beginning of each school year. Teachers and engineers are busy people. Memos and phone calls get things done. If a decision is needed, the chairman makes it.

3. We encourage clubs to meet outside school hours. This discourages hangers-on and those who have no real desire for accomplishment.

4. All technical societies are urged to cooperate. It has become the custom of many of these societies to invite Junior Engineers to their meetings when the meeting is held in Winston-Salem.

5. We do not push a program of our own. But we do push all other programs, such as the science fairs sponsored by the Academy of Science and the essay contests of the National Science Foundation. We also encourage individual clubs and students who need help. To stimulate the greatest interest we offer our teacher-sponsors cash awards with matching funds from the state Society of Engineers.

Companies Donate Materials

As liaison engineers, we back up the teacher-sponsor. We have the obligation to find speakers on particular subjects from among our associates. Many excellent films are available from industries' files. In addition, we can generally lay our hands on scrap material in our plants that our companies are glad to donate to the clubs for their projects.

We try not to interfere with the schools or their programs. We try to help. In so doing each of us active with the clubs has had many rewarding experiences and has added real stature to his own professional development.

As chairman of the clubs, I'm sure I speak for all the engineers in the area when I say that we are proud to have been associated with so many dedicated teachers—and students. We are also proud to be members of an engineering group that has given so willingly of its efforts without regard to race or creed of the recipients.

Engineer W. H. Cooper (center) presents first-place award check to Sister Irma Mildred, and second-place check to David Lash for their work as sponsors of Junior Engineers Clubs. Both teachers poured their awards back into club activities.

M. Kronenberg, consulting engineer of Cincinnati, has been appointed full professor emeritus of the Technical University of Berlin. A university professorship in Europe is considered a research assignment rather than a teaching job. Dr. Kronenberg has specialized for 30 years in machining research and machine tool development. He was awarded the ASTE Research Medal for 1958.

Norton Co. has announced two appointments: **William A. Simonds,** Houston chapter member, abrasive engineer in Texas for several years, has been reassigned to the western Massachusetts area. **Robert C. Divoll,** Pittsburgh, will succeed Simonds in Dallas.

M. Kronenberg

Roy Romine

A new division of Wheelabrator Corp., Mishawaka, Ind., formed as the result of having acquired the former Crandall Engineering and Mfg. Co., Inc., of Vicksburg, Mich., will be known as the Techline Div. **Roy Romine,** Kalamazoo chapter, who founded Crandall Engineering in 1957, will be chief engineer.

Dimitri Yasinczuk, Boston, has been made supervisor of quotation section for high-speed cutting tools in the Cutting Tool Div. of Brown & Sharpe Mfg. Co., Providence, R. I.

Announcement has been made by the Capewell Mfg. Co., Hartford, Conn., of the appointment of **Robert O. Bjorn** of the Peoria chapter to sales engineer in the Chicago area.

Robert E. Sansonetti, Pittsburgh chapter, formerly with Latrobe Steel Co.'s Pittsburgh branch office, has been transferred to the southern Connecticut area with headquarters at Latrobe's Hartford branch office.

H. R. MacLeod

members in the NEWS

Harrison R. MacLeod, member of Lorain County chapter, methods engineer for the Colson Corp., makers of casters and materials handling equipment, has been appointed chief engineer of their new Jonesboro, Ark., plant. Previously, Carter was supervisor of the methods and time-study department with the Service Caster and Truck Corp.

Howard J. Millard, 1957 professional engineering chairman for Kokomo chapter, passed his Indiana professional engineering examination and is now a licensed professional engineer. Millard is a tool engineer at the Delco Radio Div. of General Motors Co. at Kokomo.

Standard Locknut & Lockwasher, Inc., announces the appointment of **Charles F. Schanke,** editor of the Indianapolis chapter bulletin, as plant manager.

Robert C. Ressler, Ann Arbor chapter, vice president of the Hoover Ball & Bearing Co., has been appointed general manager of the firm's Ball and Bearing Div. He will be in charge of the entire operation, including sales, accounting, manufacturing, engineering and personnel activities.

Prof. Chester A. Linsky of the Pennsylvania State University industrial engineering department has accepted a position as automation consultant with the European Productivity Agency (EPA). Headquartered in Paris, he will travel throughout Europe lecturing and giving short courses on his specialty for the small manufacturers on the Continent. The EPA is a branch of the Organization for European Economic Cooperation, a permanent body set up in 1947 under the Marshall Plan and receiving financial support from 14 member nations and the U. S. Government. Prof. Linsky is an ASTE member-at-large.

Harvey D. Chicoine, former assistant manager of manufacturing, has been appointed plant manager for the Cleveland Works of Westinghouse Electric Corp. His responsibilities include all plant operations at the Cleveland Works as well as the activities of the industrial relations and purchasing departments.

Howard R. Hoskins, Lorain County, formerly sales engineer in eastern Ohio and western Pennsylvania, has been appointed sales manager for the S. W. Card Div. of Union Twist Drill Co.

William L. Dolle, president of the Lodge & Shipley Co., machine tool manufacturers, Cincinnati, was recently awarded a 35-year service pin. In addition, Dolle was lauded for his accomplishments in diversifying the company's products and in stabilizing employment.

Pratt & Whitney Co., Inc., has appointed **Chrysostom B. Blanchard** to be superintendent of the gage division to replace **Harold G. Lucas,** who will retire in October. Both are members of Hartford chapter. Blanchard joined the company in 1937, served his apprenticeship, and in 1940 began his rise through supervisory ranks in the gage division. Lucas, whose association with Pratt & Whitney dates from 1917, has been head of the division since 1945.

Frank Soper, Elmira, has been named head of sales in the barrel finishing section of BMT Mfg. Corp. Soper has worked for the Elmira Heights firm for seven years as a service engineer, and has been instrumental in the development of new methods for slide honing.

The Stanley Works has appointed **Gustave W. Lateste,** Hartford, to chief staff engineer for the Stanley Hardware Div.

chapter news and views

LONG ISLAND—At the July meeting of Chapter 88's executive committee are (left to right) First Vice Chairman Sheldon Meyers; ASTE National Education Director Gilbert E. Seeley; and Chapter Chairman Jerome Barfus. The chapter officers and Seeley discussed plans for educational programs during the year.

Denver Chapter Helps University Set Up Tool Engineering Course

A new tool engineering course is being offered for the first time this semester at the University of Colorado Extension Center in Denver. Mats Sjodin, education chairman of the Denver chapter, and Clyde P. Elliott and many other members of the chapter, were instrumental in originating the new course at the university and are convinced that this is the first step in constructing a first-rate tool engineering college in Denver.

The class is in tool design, and is being taught by Prof. R. H. Crawford, head of the engineering drawing and machine design department on the University of Colorado campus.

Basically the tool design course will teach the student to develop ideas into practical specifications for modern manufacturing methods. Among facets of the subject to be covered during the course are: tool drafting, manufacturing processes as they affect the designer, properties of materials, tolerances and allowances, springs, welding, cutting tools, punch and die design, gage design, jigs and fixtures, cam design and turret lathe tooling. Emphasis will be placed on the importance of tool design in relation to the economical manufacture of products. The course is for credit toward a bachelor of science degree and is offered to regular as well as special engineering students.

ASTE National Director Les Seager helped set up the course.—*D. S. Taylor*

St. Louis Schedules Suppliers' Night

Supplier members of the St. Louis chapter will get a chance to display their latest designs in tools, gages and production equipment at the annual "Suppliers' Night" scheduled for Oct. 2 at the Coronado Hotel. Some 40 exhibitors are expected to take part in the show, which has proved to be one of the most popular programs staged by Chapter #17. The event will be held as part of the regular monthly dinner and business meeting.

Tool Design Contest Draws Entries from 17 Long Island Schools

Entries were received from 17 high schools in Long Island chapter's first tool design contest, Chairman Robert Keegan of the chapter's education committee has reported.

Keegan has already initiated plans for next year's contest, and hopes that the number of participating schools will double. For many of these institutions, he said, this contest represented their first contact with the ASTE and the Society's functions on the local and national scene.

A drawing of a torque box bearing end and its accompanying operation sheet presented the contest problem. Operation No. 30 on the operation sheet called for five $\frac{1}{8}$-inch-diameter holes to be drilled through the bearing flange, using a drill jig. The contestant designed the drill jig for this operation. The hole pattern was not equally spaced about the flange, and here the designer had to call on his knowledge of trigonometry in his calculations.

Winning entries were chosen on the basis of originality, practicality, neatness and accuracy. The first three winners received $100, $75 and $50 savings bonds. Additional prizes included drafting sets and technical handbooks. The winners and their high school principals, teachers and parents attended the June 9 meeting as guests of the chapter, to participate in the presentation of the awards. Top winners were D. Braz, Freeport high school, first; Robert Guarriello, Seaford high school, second; Robert Kenney, Mineola high school, third.

Judges were Jerome Barfus, manufacturing engineering supervisor at Grumman Aircraft Engineering Corp. and present chapter chairman; Eugene A. Muller, tool engineering supervisor at Republic Aviation Corp.; and William Griffiths, tool engineering supervisor at Fairchild Engine Div.

McKenna Will Address Carbide Tool Graduates

Of interest to west coast tool engineers is the first class under a carbide tool training program which is being sponsored by the Los Angeles chapter of the Society of Carbide Engineers. Culminating the eight-week course on November 18 will be a dinner, presentation of diplomas and an address by Philip M. McKenna, president of Kennametal, Inc. of Latrobe, Pa. McKenna won a 1955 ASTE engineering award.

Four Topics Selected For Illinois' Annual On-Campus Conference

"Tools for Today and Tomorrow" has been chosen as the theme for the eighth annual Tool Engineering Council, scheduled for November 1 on the campus of Rockford College, Rockford, Ill.

Representatives of six of the eight Illinois ASTE chapters, in addition to representatives of the college, at a recent planning meeting selected four general topics and appointed a chairman for each subject division. Those topics and chairmen are: Operation Research, with L. Doyle, Chapter #5, as chairman; Precision Gears, L. Johnson, Chapter #31; Mechanics of Metal-Cutting, Prof. Kenneth Trigger, University of Illinois; and Precision Molding, R. Keck, Chapter #72. Complete programs listing lectures and affiliations will be distributed to all ASTE members in Illinois, Wisconsin and parts of Iowa several weeks before the conference.

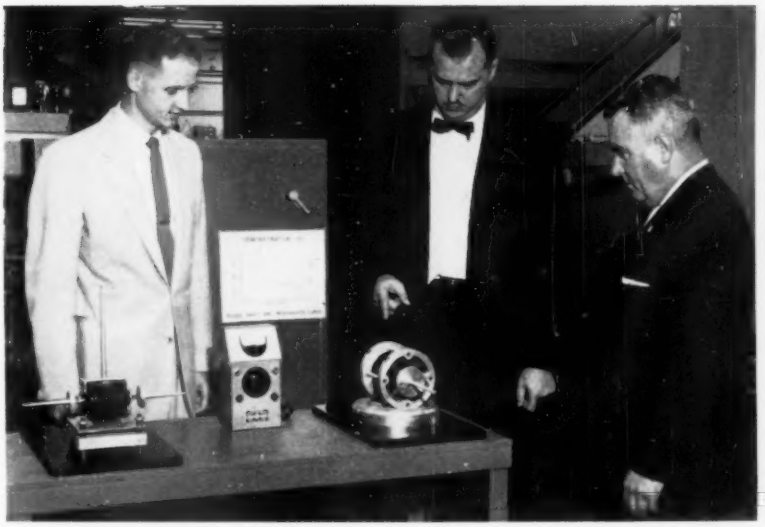
In addition to the technical sessions on Saturday, plant visitations have been arranged for Friday night, Oct. 31, to the Woodward Governor Co. and the J. L. Clark Mfg. Co. Saturday lunch will be served at the Barber Colman Co. cafeteria across the river from the campus. Main speaker at the Saturday night dinner at the Faust Hotel will be Dr. Leland Carlson, president of Rockford College. That hotel is to be conference headquarters, and a registration area will be set up in the lobby on the evening of Oct. 31.

General chairman of the on-campus conference is H. A. Nelson of Barber-Colman Co.'s Park plant at Rockford. Serving as cochairman is Walter Fraser of the National Lock Co. Anyone wishing to preregister may do so with the chairmen.

Hartford Chapter Plans Two Seminars in Spring

Chairman Paul E. Dillberg and Education Committee Chairman Ernest F. Osterling of Hartford chapter have jointly announced that two seminars are tentatively scheduled for next spring in Hartford. Plans for a Metal-Cutting Review on March 11-12, 1959, and for a Numerical Control Systems seminar on May 12 were formulated as a result of a meeting of the chapter's executive committee with Gilbert E. Seeley, national education director of the Society.

—E. Russell Carter, Jr.



MACOMB—Examining models to be used in their talks at meeting at Macomb chapter are (left to right) Philip K. Trimble, Bert M. Morgan and Charles W. Phelps, all of GM research staff. Model on the left is static and dynamic resonance demonstrator; on right is model to show mechanical phenomena of resonance and phase shift.

Machinability Course Scheduled at Boston

Boston chapter will sponsor a lecture series on machinability at Massachusetts Institute of Technology, starting Oct. 14 and ending Oct. 28. The lecturer will be Richard Yanis, machinability engineer of the General Electric Co.'s Lynn plant. His topics will include economics of machining, tool life, and modern tooling for standard machine tools. A certificate will be given for completing the lecture series.

—Charles Moody

SANTA ANA VALLEY — Membership Chairman Len Mazze (behind the badge) presents Harry Sigeske with an engraved cigarette lighter for bringing five new members into the chapter.

—Robert C. Gordon

Macomb Chapter to Hear Three GM Researchers

Three men on the General Motors research staff will discuss balance engineering at the Oct. 2 meeting of Macomb Chapter #142. The meeting will be held in the Research Building at the GM Tech Center, near Detroit, following a 6:30 p.m. dinner at Beverly Hills Country Club.

Bert M. Morgan, general supervisor of the balance engineering shop at the Tech Center, will speak on "Practical Technique Applied to Shop Balance Problems." He will use a working model to demonstrate the mechanical phenomena of resonance and phase shift.

Philip K. Trimble, electronics engineer, will talk on "Electrical Means of Separating Out the Unbalance Sine Wave Signal for Various Noise Disturbances." He will demonstrate GM's new "Unbalance Simulator," which greatly simplifies the setting-up and calibration of the Pulse Synchronized Unbalance Indicator (PSUI) to a new balancing job.

Charles W. Phelps, assistant head of the special problems department in the balance engineering section, and chairman of the Master Mechanics Balancing Committee, will describe the installation of 48 hot test stands at Chevrolet-Tonawanda. He will tell how V-8 engines under test are run under their own power and held to a balancing limit of $\frac{1}{2}$-ounce inch. Phelps is immediate past chairman of Chapter #142.

—Joseph Fox

SAN FERNANDO VALLEY—Membership Chairman Walter Shannon welcomes four of the six new members attending their first meeting. Smiling their appreciation of the special welcoming ceremony begun at this meeting are, to Mr. Shannon's right: Roy L. Craig, John A. Kubik, Marcel D'alcomo, and Ken W. Neel.

San Fernando Tests Orientation Plan

An indoctrination procedure for the welcoming of new members, based on a plan suggested by the national public relations committee, was given its initial tryout at the July meeting of the San Fernando Valley chapter. Six new members, distinguished by identifying gold lapel ribbons, were welcomed by Membership Chairman Walter Shannon, and versed by him in the objectives of the Society and the many services available to them as members.

Seated at their special table, they heard him describe the tool shows, technical papers, THE TOOL ENGINEER, Data Sheet service, ASTE handbooks and, perhaps most important, the chapter meetings, which would keep them up to date professionally. After the talk, they were presented with complimentary membership pins provided at chapter expense.

The technical portion of the meeting was devoted to a lecture by Frank H. Squires, director of quality control for Topp Industries, Inc., on "Who Inspects the Inspector?" In his discussion of procedures used by quality control engineers who check for the human error in the regular inspections, Mr. Squires admitted the existence of the same possibility for error by the quality controllers.

He maintained, however, that such possibilities were greatly reduced because the control engineer is not a part of the planned movement of material through the manufacturing processes. He starts with random samples of the finished product and works backwards, giving both functional and visual tests and, finally, disassembles the units for individual part inspection.—*Art Hunter*

Pittsburgh Plans Small Tools Seminar

A "Small Tools Seminar," fourth annual event of this type to be sponsored by the Society's Pittsburgh chapter, will run for five consecutive weeks, starting Oct. 6 and ending with a "Stump the Experts" night on Nov. 7. Carnegie Tech will host the technical sessions which, if history repeats itself, will draw some 300 tool engineers from surrounding areas.

Speakers from Cleveland Twist Drill, American Heller Co., Butterfield Div. of Union Twist Drill, Brown & Sharpe, and others will lecture, and comprise the panel of experts who will answer questions submiitted by the students on "graduation" night.

The four weekly discussion topics are drilling, threading, milling and reaming.

Vincent McLaughlin, chapter education chairman, heads up this year's seminar, which will cost $4 for members, $7.50 for nonmembers.

—*Russell V. King.*

Positions Available

WANTED TOOL ENGINEERS — A leading manufacturer of guided missiles located in the southeast has openings for tool engineers with experience in one of the following fields: machine tools — gaging — assembly — project. Send resume including education, experience and salary expected. Outstanding benefits and opportunity available. Write to: Box 127, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

MACHINE TOOL SALESMEN AND REPRESENTATIVES WANTED—Excellent opportunity to represent machinery firm in your area with full established line of new equipment (and/or used). Only apply if you have top sales record. Send all details first letter. Correspondence confidential. Write: L. D. Srybnik, S & S Machinery Co., 140 53rd St., Brooklyn 32, N. Y.

Position Wanted

IDEA MAN—toolmaker (G.E. Co. App. Grad.), tool designer, die designer, factory superintendent, age 40, married. Interested in creative work in research and development methods, or similar occupation. Broad experience in manufacturing processes. Write to: Box 128, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

TOOL AND DIE DESIGNER OR ESTIMATOR—39-year-old man with practical experience in shop and drawing board as well as in estimating tools, dies, and stampings, desires position as tool and die designer or estimator in Los Angeles area. M. E. graduate of Chicago Technical College. ASTE member. Write to: Box 129, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

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Obituaries

Tool Firm President Dies in New York

Melvin H. Emrick, president and board chairman of Ettco Tool and Machine Co., Inc., Brooklyn, N. Y., died of a heart attack. He was 47.

Emrick was a member of the Greater New York chapter of ASTE for over 25 years. He was considered an expert in machine tool design, and held many patents in the drilling and tapping field.

He received his degree in mechanical engineering from Pratt Institute in 1931, and shortly afterward joined Ettco Tool Co. The firm was founded by his father, the late George W. Emrick.

Raymond W. Bowne, Merrimac Valley, draftsman for Goodwin & King.

George Christiansen, Muskegon, assistant master mechanic for Norge Div., Borg-Warner Corp.

C. J. Cowles, Chicago, president of Cowles Engineering Co.

William J. Fiala, Fox River Valley, toolroom foreman, Harnischfeger Corp.

Percy C. Gibson, former member of Indianapolis chapter and charter member of Kokomo chapter, president of Kokomo Machine Co.

Herman Harad, Northern New Jersey, tool engineer for Curtiss Wright.

Harry A. Hayes, Riverside, tool engineer for Hunter Douglas Co.

Robert J. Herman, Detroit, design instructor at Detroit College of Applied Science, and also connected with Chrysler Missile Div.

Erich M. Hofmann, Cleveland, president of E. Hofmann Engineering Co.

William M. Horton, Santa Clara Valley, sales engineer for BHS Machinery Sales Co.

Stephen A. Kolbe, Lorain County, supervisor for Thew Shovel Co.

Erie Chapter to Hold On-Campus Conference

Two hundred area tool engineers and students are expected to attend an all-day technical conference and exposition at Alliance College, Edinborough, Pa., on Oct. 4. Five speakers have been scheduled for the session, which is sponsored by Erie chapter.

SPECIAL EVENTS

ASTE West Coast Tool Show.
Sept. 29-Oct. 3, Los Angeles Shrine Exposition Hall.

ASTE 27th Annual Meeting.
April 18-22, 1959, Schroeder Hotel, Milwaukee, Wis.

CHAPTER MEETINGS

PLACE	Oct.	SPEAKER	SUBJECT
Baltimore. Mervo-Tech Auditorium. 9 am-4:30 pm	24-25		Workshop on Tape Control
Boston. M.I.T.	14-28	Lecture series	Machinability, Economics of Machining, Tool Life, etc.
Cincinnati. Engineering Society Headquarters. 6:30 pm, dinner; 8 pm, technical meeting	14	**E. J. Tangerman,** Product Engineering editor	How Moscow Designs
Denver. American Legion Bldg. 8 pm	16	Representative of Richard Ives Co.	Optical Measurements. Ladies night and fashion show
Detroit. E.S.D.	16		Automation
Detroit. E.S.D.	23		Education
Elmira. National Cash Register Co. 5:30 pm	7		Father and son night. Joint meeting with **Binghamton**
Hartford. Hotel Bond. 6:30 pm	6	**Albert E. Bruke,** National Broadcasting Co. TV consultant	American Economy in an Interdependent World
Hendrick Hudson. Panetta's Restaurant, Menands, N.Y. 8 pm	15	**Clyde Sluham,** Master Chemical Corp.	Role of Coolants in Machining and Grinding of Metals. Film
Indianapolis. Antlers Hotel. 6:30 pm	2	**T. W. Farron,** Michigan Drill Head Co.	Use of Standard Components in Automatic Machine Operations
Kokomo. American Legion Home. 6:30 pm	16	Representative of The DoAll Co.	The Cutting Edge
Little Rhody. Johnson's Hummocks Restaurant. 7 pm	2	**R. J. Hudak,** Eastman Kodak Co.	Optical Gaging
Louisville. American Standard Sanitary Corp. Dinner, 6 pm; plant tour, 7:45	14		Plant tour
Macomb. Research Bldg., GM Tech Center. Dinner 6:30; meeting 8 pm	2	**Charles W. Phelps, Bert Morgan, Philip K. Trimble,** of GM Research Staff	Shop balance problems
Madison. Wagon Wheel, Rockton, Ill. 7 pm	23	**Donald K. Welles, Jr.,** Besly-Welles Co.	Tapping practices
Merrimack Valley. Greenridge Turkey Farm Restaurant. 6:45 pm	2	**Robert C. Fisher,** Cincinnati Milling Machine Co.	Abrasives Grinding Techniques
Mississippi. Vickers, Inc. 6:30 pm	3	**H. C. Yaeger,** Vickers, Inc.	Machine Tool Hydraulics. Plant tour
New Haven. The Wagon Wheel. 6:30 pm	9	Representative of U.S. Navy or Electric Boat Co.	Nuclear submarines. Plant tour
Niagara District. Atlanta Club. 6:30 pm	2		Plant tour of Cyanamid of Canada Ltd., Niagara Falls
North Texas. Western Hills Inn. Social hour, 6:30; dinner 7:30 pm	10	**Charles Fletcher,** Handy & Harman	Silver Brazing Alloys
Northern Massachusetts. Polish American Citizens Club Hall. 8 pm	21	**Stanley R. Cope,** Acme School of Die Design Engineering	Technical Consultant's Place in the Metal Stamping Industry
Northwestern Pennsylvania. American Legion Home. 6:30 pm	2	**Glen H. Stimson,** Greenfield Tap & Die	Gages—Watchdogs or Bandits
Peoria. American Legion Hall. 6:30 pm	24	Representative of The DoAll Co.	Story of the Cutting Edge. Past chairmen's night
Portland. Burns Restaurant. 6:30 pm	16	**Carl Oxford, Jr.,** National Twist Drill Co.	Modern Drills and Drilling Techniques
Racine. Diana Hall. 6:30 pm	6	**Stanley R. Cope,** Acme School of Die Design Engineering	
San Francisco. Spenger's Fish Grotto. 7 pm	22	**Carl Oxford, Jr.,** National Twist Drill Co.	Latest Methods of Drilling Techniques
Santa Ana. Palms Restaurant, Anaheim, Calif.	7	**Eric G. Gabbey,** O-Vee Spring Gauges Co.	Basic Principles of Gaging
Santa Clara Valley. Plantation in Mountainview. 6:30 pm	21	**Carl Oxford, Jr.,** National Twist Drill Co.	Modern Drills and Drilling Techniques
Springfield, Ill. Elks Club. Dinner, 6:45; technical session, 8 pm		Representative of The DoAll Co.	The Cutting Edge
Worcester. Hickory House. 7 pm	28	**Edward Kibbitt,** Carborundum Co.	Production Applications of Oxide Cutting Tools. Joint meeting with Society of Carbide Engrs.

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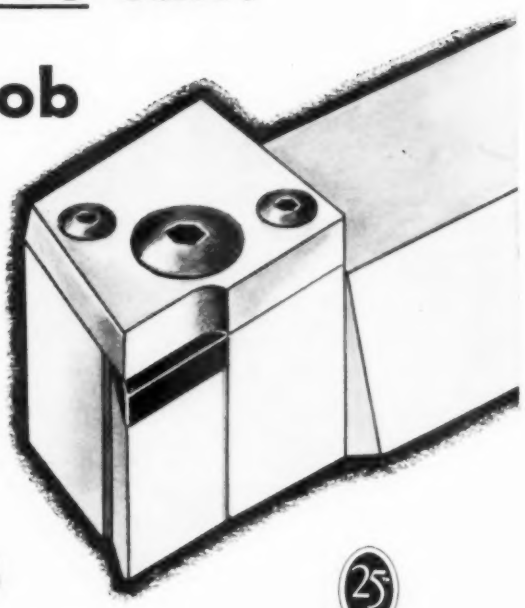

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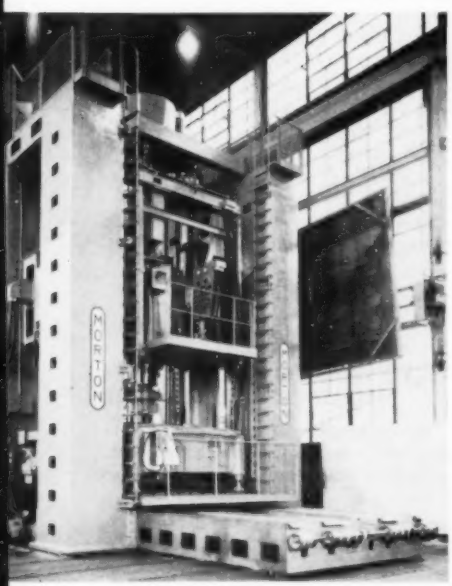
When tool heads must be changed on the mammoth machine recently introduced by Morton Manufacturing Co., an elevator hoists the operator to the job. Front platform of the machine elevates independently of the bridge with a 10-foot travel.

Also, closed-circuit television helps the operator keep the work and tools under close observation. Camera of the TV setup rotates on the spindle with the tool head, with power to spindle tool



heads and the television circuit transmitted through 48 slip rings at the top of the spindle. The visual indicator is selsyn driven. Power to the turning ring tool heads is transmitted through 10 slip rings located in the turning ring.

The 40-ft-high equipment is to be used to machine high-pressure sections of large steam turbines. Load capacity of the worktable is 60 ton. Power for the giant comes from 19 motors that provide 210 hp. The machine also can use electronic numerical control for prepositioning tools vertically or radially.

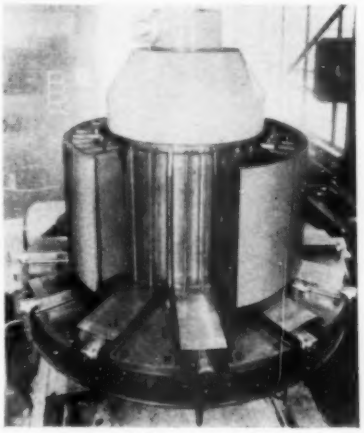
PRECISE EXPANSION METHOD 'ROLLS OUT' COLD METAL

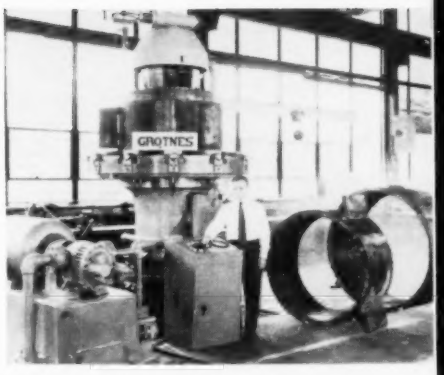
Force of more than 1580 tons can stretch a steel ring weighing over 1½ tons with about the same ease that a housewife forms pie dough was shown at a demonstration recently at the Grotnes Machine Works, Chicago, designers and builders of heavy metal-forming equipment for the automotive, metal container, aircraft, appliance and power industries.

In a demonstration of this technique, Grotnes Machine Works showed a new metalworking machine expanding a part 60 in. in diameter, 26 in. in height, and with a 2-in. thick wall which was expanded and sized to within ±0.010 in. of a true circle. This entire operation, which takes only one minute, is performed cold with no heating of the part; the power applied is so great that metal flows cold to the desired size and diameter.

The machine has the power to expand 60 sq in. of metal having a yield strength of 46,000 psi. Replaceable dies are machined to the desired finished internal diameter of the part which it is to process. These dies can be interchanged with others so that parts of other diameters can be handled.

Close-up of the head shows the expanding jaws and table with two die segments removed. Total size of the machine can be visualized by the 6 ft diameter of the table.





The powerful Grotnes expander, with 3000-lb part in place, is 14 ft in height. It will be set into a pit and has a drawbar pull of 1580 tons. Shown right to left are the hydraulic pump and electric motor, the expander itself with John R. Fox of the Grotnes organization at the control panel, and at the right, two different rings expanded and sized on the machine.

The electric drill device at the top of the machine is for rotating the drawbar nut which moves the cone up or down on the drawbar to adjust the expanded jaw diameter.

An unusual feature of the machine is the power that is concentrated in a relatively small machine—it weighs approximately 65,000 lb, is 14 ft high, 7 ft wide by 7 ft deep.

By company estimate, economies resulting from cold forming of the 60 sq in. of metal to the close tolerances required by the machine buyer will amortize the $100,000-cost of the unit in less than 18 months through material and labor savings.

Since an accuracy of ±0.010 in. on the diameter can be obtained by expanding, the stock thickness of a typical part was reduced from 2½ to 2 in. with proportionate reductions in stock cost and handling time. There was no need at all for rough turning operation which consumed 70 minutes to remove approximately ½ in. of wall thickness to

New TUMBLE JIG

Available in 47 sizes

Patent Applied For

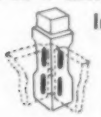
Offers Many Big Advantages

- ONE-HALF THE WEIGHT
- TRI-METAL CONSTRUCTION — Aluminum — Cast Iron — Steel
- 6-SIDE UTILITY — Can Use Head-Type Bushings, on Sides, Top, Bottom
- 5 HANDLE LOCATIONS — Handle can be attached to Any Side or Bottom
- ONE HAND OPERATION — Thumb screw releases Lid Instantly
- LEAF "POP-UP" — Automatic Action Spring Plunger Snaps Lid Open
- STABLE — Rugged Construction

Standard Parts is First with Exclusive New "TUMBLE" Box Jig

New design features, new engineering concepts, new construction techniques . . . are incorporated in this outstanding line of "Tumble Box Jigs. By combining 3 metals — aluminum, cast iron, steel — half the weight has been eliminated. This increases efficiency and production. The sturdy handle (can be located on any side) makes tumbling fast, easy and safe.

Bushings can be used on all 6 sides. A unique interlocking feature is the aluminum through the cast iron legs, which assures strength and stability. Walls can easily be machined without distorting the Jig. 47 Sizes available 1" x 1" x 1" to 4" x 8" x 4". *Full size Tracing Templates are available for all 47 sizes.*



Interlocking Leg Joint

Aluminum goes all the way through the cored slots in the cast iron legs — forms a unified, interlocking joint — assuring light weight, but rugged strength.

HANDLE may easily be attached on any side or bottom of the jig as needed.

TUMBLE — Universal tumble direction is advantage of this light-weight jig — where handle can be located where desired.

Ask for TUMBLE JIG BULLETIN

STANDARD PARTS CO.

1012 BROADWAY • BEDFORD, OHIO

INDICATE A-10-142

obtain the necessary roundness.

A part can be as much as 1 in. out-of-round when leaving the coiling roll since the Grotnes expander performs both the sizing and rounding operations simultaneously. In previous production, roundness was achieved through coiling followed by considerable machining.

'JET AGE' ALLOY MEETS HIGH TEMPERATURE NEED

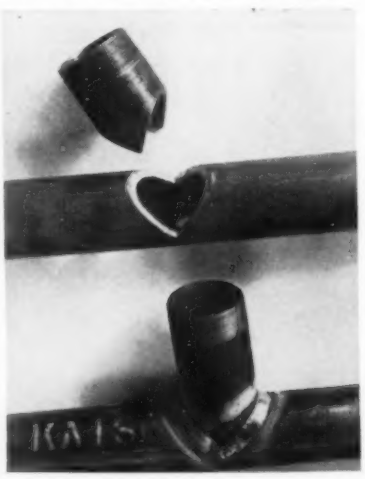
A nickel base, titanium-aluminum hardened alloy, initially developed for use in severely stressed jet engine components, is also being found suitable for many applications where high-temperature resistance and performance reliability are required. The René 41 alloy, created by General Electric Co., can be formed, welded and machined with relative ease when compared with other materials designed to operate in a similar temperature range. It can be used effectively through the entire range from room temperatures to 1800 F by appropriate heat treatment.

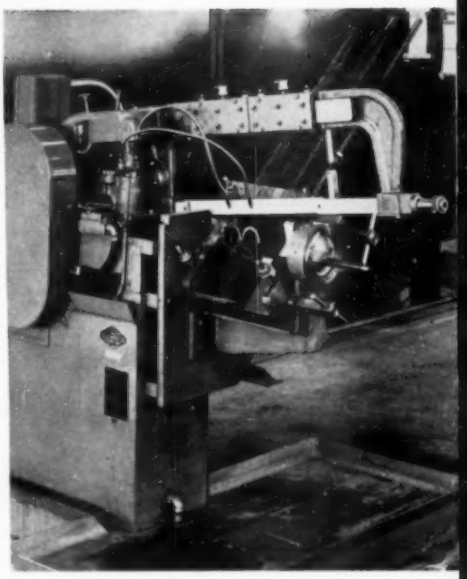
The metal can be inert-arc welded with or without filler material, and also offers strong, ductile spot welds. Tests show that welds closely approach strength of the base metal. Strength tests of the alloy with optimum heat treatment indicate that the 0.2 percent offset yield strength at 1200 F is 125,000 psi. The 100-hour stress rupture strength at 1600 F is 25,000 psi.

SAW ADAPTATION SOLVES JOINING PROBLEM

Creation of a special hack saw arrangement resulted in an adaptation of equipment to cut 45-deg notches in pipe. Ingenuity was supplied by engineers at the Machinery Div. of Racine Hydraulics & Machinery, Inc. to meet a need by

Matched cuts simplify the welding job.





The metal cutting saw has controlled hydraulic feed and automatic knock-out. Pipe is cut in pairs to assure match.

American Blower Div. of American Standard.

End use of the products is coils used for heating or cooling in air conditioning units. Notches are sawed in pipes, then nipples are cut to match and the two are welded together. All work is cut in pairs.

Machine which does the work is an adaptation of a Stub Model 816-W4 with a face plate and indexing fixture. It uses an 18-in. molybdenum high-speed steel blade. The unit has a 5-in. stroke and can be operated at 35, 70, 100 or 140 strokes per minute.

TECHNIQUE FOR TITANIUM SIMPLIFIES FORMING JOB

To operate the many pneumatic controls and other devices on jet aircraft, air is bled from the compressor section of the jet engine and conducted through strong, lightweight ducts. For ease in assembly and for rapid maintenance, ducts are made and installed in short sections held together by quick disconnect couplings. Until recently, both the ducts and the couplings were generally made of stainless steel. But as new demands are made on aircraft performance, weight must be trimmed to achieve greater speed and range.

Janitrol Aircraft Div. of Surface Combustion Corp. uses titanium in the flange portion of couplings. While the metal is light in weight and quite strong, it is difficult to fabricate without special techniques. One such technique is the method for hot forming flange lips.

Titanium tubes are first end-squared,

deburred, and thoroughly cleared. Ends of the tubes are placed in special furnaces where they are heated to working temperature and held for three minutes. Heated tubes are rapidly transferred to a die forming machine containing a die set of the proper size.

The operator closes the die on the hot tube and depresses a foot switch to start a self-timed 4½-minute forming cycle. An automatic mandrel stretches the tube wall into the die cavity. The forming machine is then set for a cold forming sizing operation in which dimensions are set to precise tolerances. The formed flange is friction sawed away and the remaining tube goes to the beginning of the production line as raw material.

Rough-sawed edges are removed by chucking the flange in a lathe and machining with a single-point tool. After the flange is given a hydro-hone finish, it is again chucked on the lathe where a 1-degree face is machined into the mating lip of the flange. Microfinishing is the last step prior to inspection and shipment.

Couplings of similiar function and performance illustrating weight and size savings of aircraft design (left) over commercial-industrial design shown at the right.

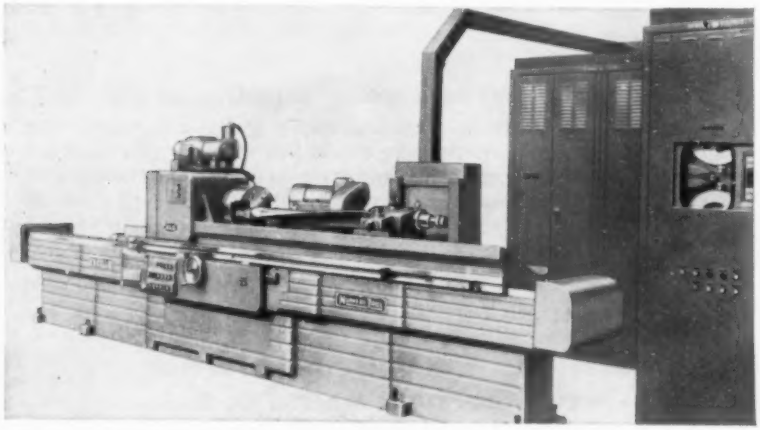
THREE DIMENSIONAL MILLING GETS NUMERICAL CONTROL

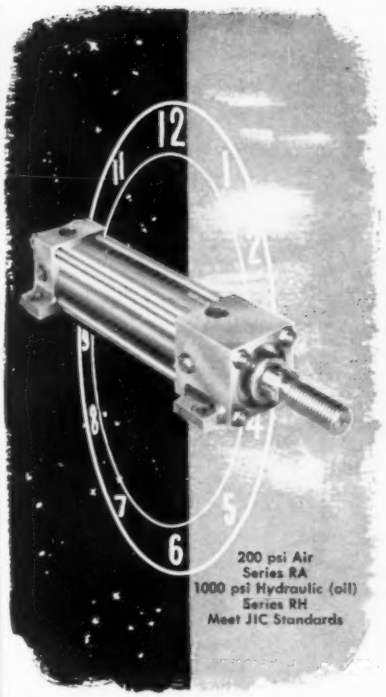
Numerically controlled three-dimensional machining equipment developed by Ex-Cell-O Corp. is equipped for milling and grinding and incorporates compensation for grinding and dressing. Irregular and twisted forms can be machined without cams or special tooling. It was designed to operate from any high performance numerical control system.

Cast base of the Numeri-Trol unit is ribbed for strength, while leveling pads and jackscrews permit precise leveling and alignment. The accurately controlled table is so supported that it can be moved with a breakaway force of only 18 lb, and a pull of 14 lb will keep it in motion. The cross slide, cast of aluminum for minimum weight, supports interchangeable milling and grinding assemblies.

Spindle, gear motor and silent chain drive, all mounted on a base, make up the milling unit. Grinder assembly consists of precision grinding spindle with its drive equipment and hydraulically operated swivel type diamond dresser assembled on a base. A slide mounting provides axial movement for the spindle. An elongated cup type grinding wheel is dressed to a spherical shape of a definite radius which is maintained throughout life of the wheel. Regardless of the dressing operation, position of the grinding wheel in relation to the work is maintained. The dresser remains stationary while the wheel spindle moves toward it. This works as an automatic sizing device, restoring the wheel to its original position in relation to the work. Thus amount dressed off the wheel is compensated for automatically.

Pause in the machining cycle, withdrawal of the cross slide for dressing operations and frequency of dressing are tape controlled. During grinding and in rotary milling operations, one motor drives the work spindle and the leadscrew to give the desired feed. For longitudinal milling, work feeds lengthwise in relation to the milling cutter, then indexes and feeds back. Feeding and indexing continue until work is rotated 360 deg.





FULL 'ROUND THE CLOCK OPERATION

O-M AUTOMATION
heavy-duty air and hydraulic cylinders

O-M Automation Air and Hydraulic Heavy-duty Cylinders are the result of years of research and engineering "know-how". Designed to the automotive industry's Automation Standards, they fill a definite need for outstanding durability under the most exacting demands of today's high speed automatic production.

Tested, tried and proved in actual service, these ruggedly constructed components hold untold promise for design engineers who seek to combine continuous, smooth dependable and efficient straight line motion with long life and minimum maintenance. Available in 1½" to 8" bores with front flange, rear flange, clevis, trunion or foot mount.

These and many other advanced features of O-M Automation Cylinders, that make for maximum efficiency and long life with minimum servicing, are described in our new catalogues—107 for Air Cylinders—108 for Hydraulic Cylinders. Write for your copy TODAY!

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INDICATE A-10-143

HY-PRO specialized tap engineering tells you

which tap where

for lowest cost per hole

New alloys, new plastics, new tooling set-ups, and mounting production demands pose new problems daily in tap selection and use. HY-PRO tap engineering service provides prompt answers . . . the *right* answers that mean steady savings in tap expense, in time loss on the line, in reduced parts spoilage.

in plastics

Abrasive composition of most hard plastics requires Hy-Pro's multi-fluted design, .0025 oversize, with the exclusive Hy-Pro "Hardernell" finish for maximum wear resistance and free-cutting.

in die castings

Relative softness of alloys used causes tendency to close in and bind the tap. Hy-Pro's 2 flute spiral point oversize design meets these conditions, — provides free-tapping, clean threads.

in stainless steel

Hy-Pro spiral point design provides high-hook angle for most efficient cutting of this metal, and maximum tap strength. Ferrox surface treatment counteracts chip welding.

in aluminum

Hy-Pro's spiral (1) flute tap lifts chips out, gives best results in blind holes. Hy-Pro's spiral point design (2) is recommended for through holes. Chrome plate or nitride surface treatment resists abrasive effect of most aluminum alloys.

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TAP ENGINEERING SPECIALISTS

What's your tapping problem?

Hy-Pro Tap Engineering Specialists can help you correct tapping troubles — and can often point out opportunities to cut costs in tapping operations you've considered satisfactory. It costs nothing to consult Hy-Pro Specialists, and records prove that in 8 out of 10 cases, their advice will pay steady dividends in savings. Write or phone: Hy-Pro Tool Company, Dept. C, New Bedford, Mass.

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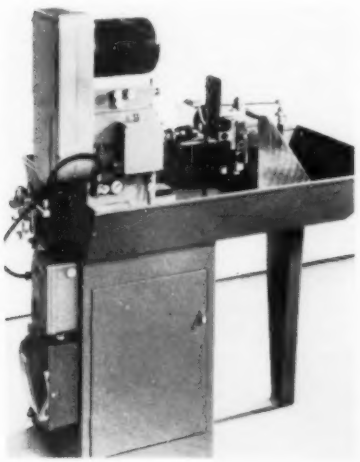
TOOLS of today

Drilling and Tapping Machine

The single-spindle horizontal drilling and tapping machine, which as a full range of automatic controls, is provided with magazine feed (adaptable to hopper feed) to handle second operation work on screw machine parts, die castings, stampings or headed parts.



Capacity includes 0.020 to $\frac{3}{8}$-in. drilling in mild steel and up to $\frac{3}{8}$-in. tapping.

A $\frac{1}{2}$-hp spindle motor and drive pulleys provide a normal speed range between 500 and 10,000 rpm. Adjustable spindle feed is obtained with compressed air through a $2\frac{1}{2}$-in. maximum stroke length. An hydraulic control adjustment accommodates for breakthrough or controlled-feed operations.

A bottom dwell control holds repeatable depth limits within 0.0005 in. The universal positioning and clamping fixture permits depth location from either the back of the part of the front face of shoulders or flanges.

Spindle operation can be synchronized with any clamping, positioning, indexing or escapement mechanisms, and also allows manual control for setup or test runs.

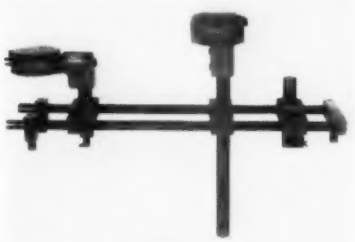
Infinitely adjustable cycle control ranges up to 500 strokes per minute. The speed of operation is determined by the nature of the work being performed. Normal shop line air pressure of 80 to 100 lb is reduced through built-in regulators to suit requirements. Less than 5-lb pressure will maintain spindle operation.

Unimatic Machine Products, Inc., 9545 Ainslie St., Schiller Pk., Ill.

T-10-1

Gage

Because of the depth gaging attachment on this ID and OD gage, depth can be measured while the device is indicating diameter. Ball, standard and offset contacts are available for all gaging members. In conjunction with measuring diameter in a 4 to 12 range,



the device can measure shallow diameters, gears, splines, tapers and various lengths. Repetition is accurate within 0.0001 in. Parts are interchangeable with any of the company's diameter gages up to 72 in. length.

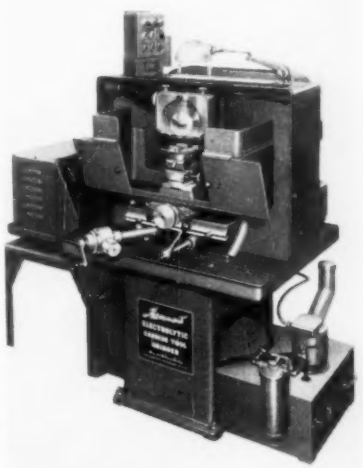
Various indications may be used on the same gage, and an adjustable setting master also is available.

WJZ Tool Specialties, Hyde Park, N. Y. **T-10-2**

Chip Breaker and Grinder

Versatile utility grinder for single point carbide tools and insert slugs, the Model CBE-66 electrolytic combination chip breaker and oscillating cup wheel grinder is designed to increase operator efficiency and operational economy.

The cup wheel utilizes adjustable oscillation; an automatic pushbutton



air table can be furnished extra. Predetermined grinding depth can be set on a micrometer dial calibrated to 0.001 in. A stop prevents table contact with the wheel, and a lock provides fixed table location for manual tool in-feed. Angular setting with a handwheel ranges from 10 deg to 25 deg below horizontal. There is no movement of the table toward the wheel.

For chip breaker grinding, oscillation is not used; a manual lock with electrical interlock prevents spindle movement. The spindle, which is insulated from the machine, is equipped

with a power pick up for electrolytic grinding; the spindle nose is tapered for wheel and flange mounting. A vise accommodates tools up to 2½ in. wide and slides in and out for loading convenience. Cross slide on which the vise is mounted has a micrometer handwheel adjustment calibrated to 0.001 in. to assure sensitive upward tool feed.

Hammond Machinery Builders Inc., 1600 Douglas Ave., Kalamazoo, Mich. **T-10-3**

Profiler

Template making, reproduction of parts from templates, die sharpening and other operations are speeded up on the profiler P-500. This machine incorporates a Micro-Feed Guide Button which allows reproduction of contours

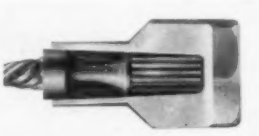
to tolerances of 0.0005 in. automatically. A ½-hp direct drive motor has continuous speed adjustment from 100 to 45,000 rpm for grinding, milling and routing of wood, metal, plastics, glass or rubber. A voltage control unit minimizes speed drop under load. There is no vibration at any speed.

The accurately ground, 18 x 18-in. table has a power quill set 3 in. off center to provide maximum use of work space. Clamping arrangements of the quill mounting allows 4 in. vertical travel and 10 deg tilt each side of vertical. The table remains flat at all times.

Tool-Lab., Inc., 836 N. Broadway, Escondido, Calif. **T-10-4**

Screw Extractor

The Wedge-Pruf screw extractor is composed of two parts. An outer hexagon jacket is spline-fitted to the heat treated high alloy extractor and shaped to allow maximum torque. Should the extractor break, a substantial portion projects above the Wedge-Pruf shoul-



der, allowing ready removal of the extractor.

Twenty-five sizes are available from ⅛ to ⅞ in. to remove broken hydraulic or tube fittings and studs.

Roddick Tool Co., 1023 Pauline St., Anaheim, Calif. **T-10-5**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Surface Grinder

The 6 x 18 in. type S-3 hydraulic surface grinder has maximum table traverse speed of 125 fpm which minimizes burn, checking and cracking of the work.

The machine also has capacity for grinding a workpiece as high as 15 in. above the worktable with a standard 8 in. diameter grinding wheel.

Long wide flat ways of the base result in minimum bearing pressure per square inch. Guide rail and preloaded ball bearing roller construction assures straightest possible cross tracking of the saddle. Design provides for rigid support even at the maximum 15-in. height.

Accurate hydraulic cross-feed at each table reversal is easily set by a graduated dial knob. A two-speed vertical feed handwheel provides rapid move-

How Can Any Hack Saw Cut As Fast As a MARVEL?

GREATER EFFECTIVE FEED PRESSURE

MARVEL Series 6, 6A, 9 and 9A Hack Saws are capable of automatically applying *more than twice the feed pressure* required for most hack sawing jobs. This means that MARVEL Saws can utilize the full strength and heat resistance of the modern composite hack saw blade which is designed to cut most efficiently under heavier feed pressures. MARVEL Dual Power Feed forces the blade to cut as deeply as possible and **practical** on every stroke—to cut-off the work in the fewest possible strokes by automatically adjusting the feed pressure in relation to the changing work resistance.

MORE CUTTING STROKES PER MINUTE

MARVEL Reciprocating Crank Lever Action, providing quick return of the saw frame on the non-cutting stroke produces 33⅓% more *cutting strokes* per minute than ordinary saws *without increasing the peak blade velocity on the cutting stroke.* Result: faster cutting-off without damage to the blade.

With far greater feed pressures automatically available, plus more cutting strokes per minute, is it any wonder that MARVEL Series 6 and 9 Hack Saws will give you faster, accurate cutting-off every time?

Write for the MARVEL Catalog and the complete story on MARVEL Metal Cutting Saws

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MARVEL Metal Cutting SAWS
Better Machines—Better Blades

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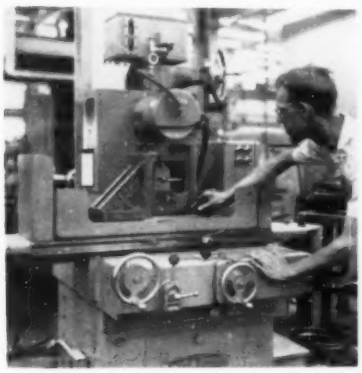
ment for positioning and a fine feed graduated in increments of 0.0001 in., for precision feed. Contouring of the wet attachment splash guards allows the operator to see the work and the wheel easily, contributing to fast, easy setup.

A centered reversing lever permits



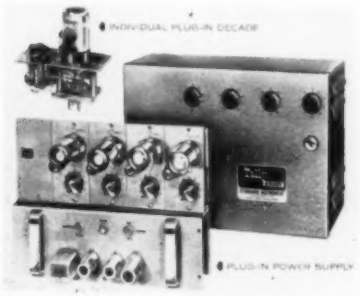
the operator to line up the table dogs with the ends of the work.

The hydraulic cylinder which normally operates the table can be easily disengaged to permit manual operation. The table traverse handwheel is interlocked with the hydraulic start-stop lever to prevent rotation of the handwheel during hydraulic powered motion.

Norton Co., Worcester, Mass. **T-10-6**

Electronic Counter

A predetermining electronic counter, called Tally-Count, automatically controls any industrial process involving high-speed counting such as batching, machining cycling, sorting, materials



handling, packaging and unit flow at speeds higher than 100 a second.

There are no moving parts and no friction; it provides accuracy at high speeds, and trouble-free operation into billions of counts.

Individual plug-in decades simplify maintenance while permitting expansion from a 2-decade to a 3 or 4-decade counter with no wiring change. Power supply also is a plug-in unit.

T-J spacemaker cylinder

Quality Engineered

to give quality results

with Extras . . .
at No Extra Cost!

You get more—much more—when you specify and use any of T-J's complete line of Spacemaker cylinders. The Spacemaker is engineered to give you better, more accurate, and longer service—offers, exclusively, many extras . . . that are STANDARD, AT NO EXTRA COST!

Designed to eliminate tie-rods, providing greater strength . . . saves space . . . reduces manhours and costs in all push-pull-lift operations. IMMEDIATE SHIPMENT in a wide range of styles and capacities, with 64,000 combinations. Write for Bulletin SM 155-3 with complete engineering details. The Tomkins-Johnson Co., Jackson, Mich.

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RIVETORS, AIR AND HYDRAULIC CYLINDERS, CUTTERS, CLINCHERS

METAL PISTON ROD SCRAPER . . . Standard at No Extra Cost!

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ONE PIECE PISTON . . . Standard at No Extra Cost!

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NO TIE-RODS TO STRETCH . . . Standard at No Extra Cost!

STREAMLINED DESIGN . . . Oil Pressure to 750 P.S.I.—air to 200 P.S.I. Standard at No Extra Cost!

FORGED SOLID STEEL HEADS . . . Standard at No Extra Cost!

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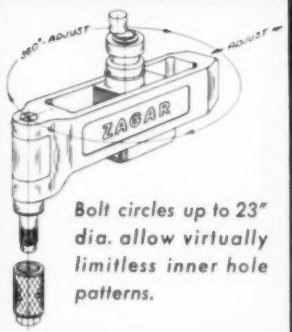
NOW - Zagar

presents a NEW CONCEPT of a MULTI-SPINDLE ADJUSTABLE HEAD

for

- *DRILLING*
- *TAPPING*
- *and REAMING*



Bolt circles up to 23" dia. allow virtually limitless inner hole patterns.

Here's an adjustable, multi-spindle head packed with features never before combined in a single tool. Zagar's famous, soundly engineered gearless drill head principle is applied to adjustable spindle drilling. There are NO universal joints, NO flexible shafts, NO bulky gear clusters.

The head is ready to use on any standard drill press for any machinable material. No auxiliary parts are needed. Spindle arms can be removed and replaced in minutes. Hole patterns can be changed as easily as spindles and at little cost.

Before you drill another hole, contact a Zagar representative, and—

Write for Data Sheets 93-E-10

Zagar

ZAGAR, INCORPORATED
23892 LAKELAND BLVD.
CLEVELAND 23, OHIO

TOOLS FOR INDUSTRY and SPECIAL MACHINERY

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-148

Tally-Count may be actuated by relay, photo-electric control, microswitch or a toggle switch. Counting capacity of a 4-decade Tally-Count (used as a predetermining counter) is 10,000. As a totalizing counter, with 4-decades and 4-digit mechanical register, counting capacity is 1,000,000.

Where Tally-Count is used as a predetermining counter, the desired number is set by selector knobs. When the preset count is reached, the device will close relay contacts to operate either or both an external device or mechanical register. It will simultaneously reset to zero and repeat its counting function indefinitely without loss of count.

A toggle switch on the instrument panel permits lock-in of control relay. Release may then be effected manually at the instrument panel, or automatically from a remote point.

Standard Instrument Corp., 657 Broadway, New York 12, N. Y. **T-10-7**

End Mills

Designed for milling aluminum and aluminum alloys, these high-speed steel end mills have a 40 deg helix angle and 20 deg rake angle to provide a shearing cut of maximum efficiency on aluminum. The 39 new end mills have good chip clearance and are made of abrasion

resistant steel to improve performance and add to tool life. There is a completely ground finish over entire mill surface with ground eccentric relief of the cutting edge.

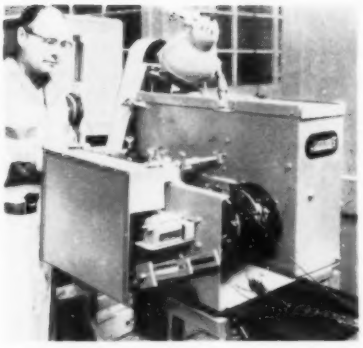
The end mills are available in three different lengths, standard, long and extra long, in sizes $\frac{1}{4}$ to 2 in. diameter inclusive.

Cutting Tool Div., Brown & Sharpe Mfg. Co., Providence 1, R. I. **T-10-8**

Wire Cutter and Stripper

Automatic from unreeling of insulated wire, through simultaneous cutting and stripping, to stacking pieces in a trough, this wire cutter and stripper is capable of processing more than 9000 pieces per hour for 1 to 40 in. wire lengths, or at rates of some 3000 pieces per hour for 80 to 120-in. lengths.

The machine handles a variety of single conductor, insulated wire, as well as solid wire and plastic or fabric tubing. For best operating results, maximum wire sizes of No. 10 ga stranded



and No. 12 ga solid are recommended. The machine's wire grip adjusts to different wire gages and sizes with such insulations as Teflon, Kel-F, cotton braid over plastic, felted asbestos, PVC and nylon. It strips "sticky" or "tacky" types of insulation as well as the hard surface types.

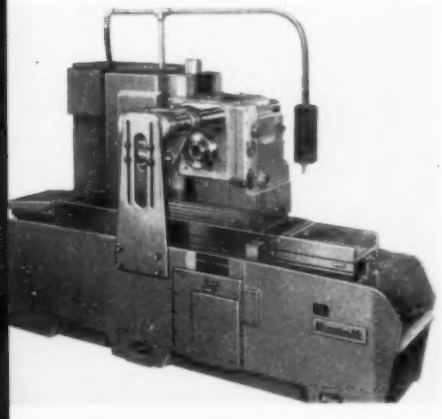
Tolerances on dimensions range from less than $\pm \frac{1}{2}$ in. on 120-in. lengths. Strip tolerances hold within $\pm \frac{1}{64}$ in. at each end, regardless of wire length. Length of the strip can be adjusted from $\frac{1}{8}$ to 1 in. on each end, or up to 2 in. on one end.

Jennings Machine Corp., 3452 Ludlow St., Philadelphia 4, Pa. **T-10-9**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Milling Machine

This bed type milling machine, called the Mil-waukee-Mil, provides automatic production milling. The operator programs machine functions on the Dial-a-Cycle control panel by means of phase-switch dials which control each machine function automatically. Any number of functions can be phased into a cycle, including automatic quill retraction, rise and fall to the head and tracer control. Operations progress from one function to the next smoothly and quickly.



Two-way milling cycles with automatic center stop for load and unload can be obtained through press of a button to resume the cycle. Stops can be made to occur at any place in the cycle. Flick of a switch changes operation from automatic Dial-a-Cycle to manual.

There are 72 standard models in both simplex and duplex styles, with power ranging from $7\frac{1}{2}$ to 30 hp.

Kearney & Trecker Corp., Milwaukee 14, Wis. **T-10-10**

Speed Changer

The Insta-Matic speed changer for lathes, drill presses, band saws and bench mills allow change of speeds instantaneously while the motor is running. The compact, easy-to-mount unit provides full power delivery at all speeds. It can be set to neutral with any one of the control knobs. This makes it particularly useful on chucking jobs, when changing collets, or for any operation where motor drag is objectionable.

Alda Plastic & Mfg. Co., 2601 Norton Ave., Lynwood, Calif. **T-10-11**

Riveting Tools

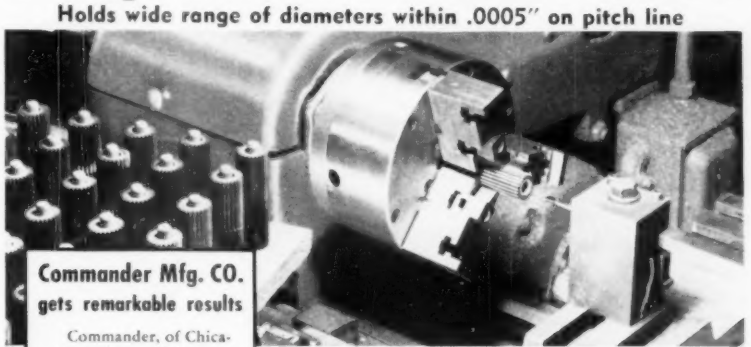
Two lightweight riveting tools, designed for assembly operations, product maintenance and repair, can be used for setting small rivets up to 3/16-in. diameter in standard, overhead, or blind applications. The hand tool, slightly larger than ordinary pliers, will set aluminum rivets of 3/32, $\frac{1}{8}$ or 5/32 in. in diameter, and Monel or steel types up to $\frac{1}{8}$ in. in diameter. The air-hydraulic gun, weighing about 2 lb will pull Monel rivets up to $\frac{7}{16}$ in. in size.

The powered tool, designated PRG hydraulic gun, consists of an air-hydraulic intensifier, a portable riveting gun, and connecting hoses. The manufacturer recommends that a water trap-pressure-regulator oiler unit be added before connecting the gun to a central supply. The intensifier connects directly to shop air outlets and operates at pressures of 70 to 100 psi. At minimum operating pressure, pistol ratios increase this to 2700 psi at the hydraulic end—a booster ratio of approximately 40:1. Maximum air consumption at 1200 cycles/hour is 1.04 cfm.

The gun will operate satisfactorily at hose lengths up to 11 ft or more. The rivet can be placed either in the gun or

Unique *Buck* GEAR Chuck

Holds wide range of diameters within .0005" on pitch line



Commander Mfg. CO. gets remarkable results

Commander, of Chicago, used to need 4 operations to process this gear; Hone I.D. of hob gear, grind O.D. of gear on arbor, press in oilite, use pot chuck on O.D. to bore oilite to .0004" tolerance.

The Buck gear chuck eliminated operations 1 and 2, speeded up 4 by 40%. Tolerance was held, scrap entirely ended. The former problem of runout from pitch diam. to I.D. was licked—it is now held to .001" with production of 70 to 85 pieces per hour.

New low costs for I. D. boring and grinding

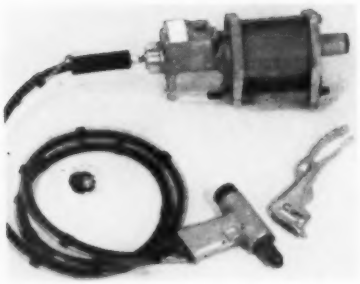
You see here the *only* chuck that gives you broad capacity in holding gears of different diameters—and holds them *within .0005" precision* on the pitch line. It's a combination of the Buck DUST-PROOF chuck and its master jaws (with full center hole capacity) plus angulate jaws to fit gear teeth. As with every Buck chuck development it is logical, it is simple, *it works*, and the cost is but little more than the standard Buck chucks.

Send for complete details. See why, more than ever, *"It pays to chuck with Buck."*

BUCK TOOL COMPANY

1033 SCHIPPERS LANE • KALAMAZOO, MICH.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-149



the work, and the cycle completed by a light squeeze on the spring trigger.

Universal, quick-change collets permit adaptability to a variety of rivet sizes. It can be used in overhead, blind and restricted areas. Special heads are available for right angle, deep-channel and formed panel riveting; and, if desired, the gun can be bench-mounted and rigged for foot-pedal operation.

Pop Rivet Div., United Shoe Machinery Corp., West Medway, Mass.

T-10-12

Specify **RING** **PUNCHES AND DIES**

for your perforating problems

Complete interchangeability

Immediate shipments from stock on Standards

High quality — Long life

LOW COST

STANDARDS IN ROUND—SQUARE OBLONG—RECTANGULAR

H. S. SHOULDER AND BEVEL HEAD QUILLS

TRANSFER PUNCHES

SLUG EJECTOR PUNCHES

PILOTS—BLANKS

PUNCH & DIE RETAINERS

CHOICE OF STEELS

WRITE FOR OUR ILLUSTRATED CATALOG 105

Let us quote on your Specials

Send prints or sketches for prompt reply.

RING PUNCH & DIE, INC.

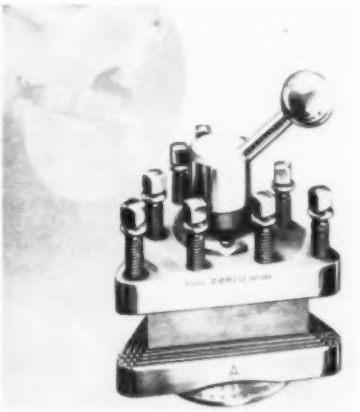
FENTON PLACE JAMESTOWN, NEW YORK

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-150

Lathe Head

This triangular shaped multiple indexing engine lathe turret head accommodates 48 repetitive indexing positions.

The 7½-deg index increment gives popular angular positioning of the tool —the 30-deg setting of a threading tool



and the chamfering angle of 45 deg, for example, can be obtained with the same tool.

The Zierco lathe head, which makes use of the minor cutting edge of the tool, is dependably and highly accurate. Design allows its cutting edge to be effectively set to the operational facing and turning of a number of tools whose repetitive indexing is limited to a solitary working position. This advantage simplifies setup.

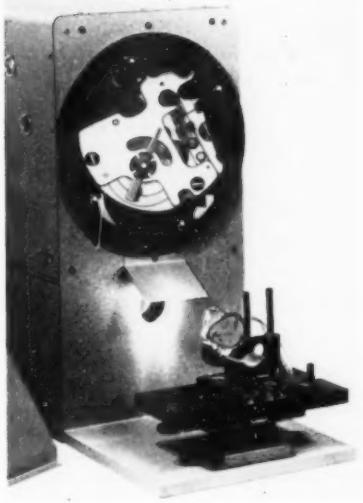
The Zierden Co., 3817 S. Kinnickinnic Ave., Milwaukee 7, Wis.

T-10-13

Production Comparator

Designed for low magnification work in the 3x to 20x range, this production projector has large-area screens, long-working distances and wide-field coverage. Contour is distortion free; surface images are bright and of clear contrast. Capacity of the instrument permits inspection of sizable parts, components, assemblies, etc., with up to 3 in. field coverage on the subject at one time. The projector may be used under ordinary room lighting conditions without curtains or enclosures.

Optical system of the projector may be completely contained within the body of the unit. Forced draft cooling prevents overheating and allows continuous use. Foot-switch control of illuminators may be used. A behind-the-screen Fresnel lens produces bright screen images, which may be observed by more than one person at one time. Charts of grid, radii, protractor or thread patterns are available in either



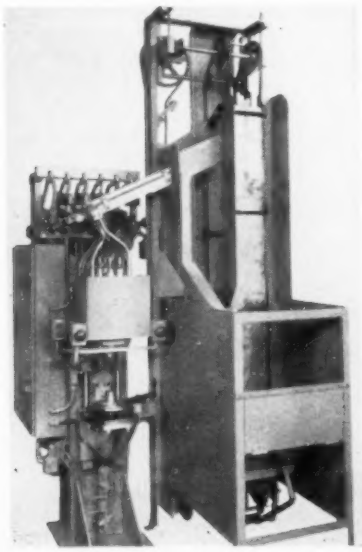
the overlay or replacement type for higher magnifications; special charts for product comparison may be made by the user's own drafting facilities.

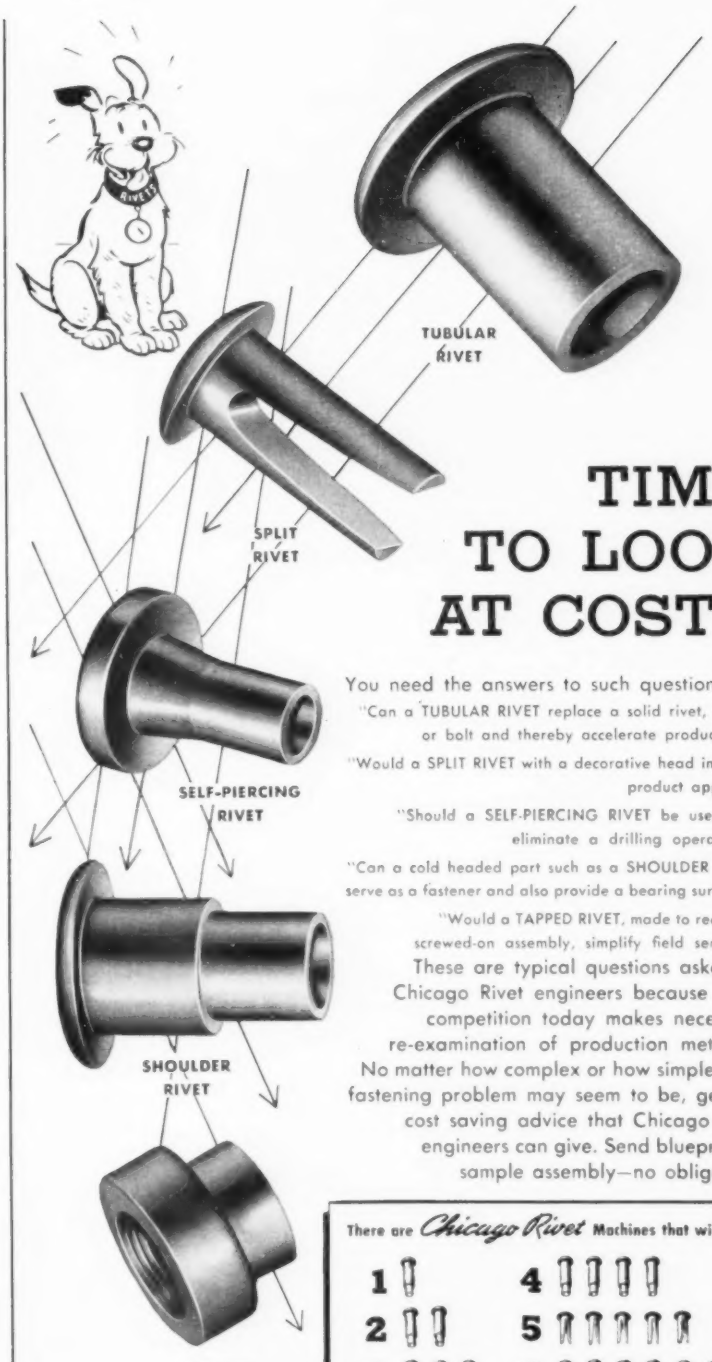
Illustration shows a typical application setup on production holding fixture and 3x image completely filling a 10 in. diameter ground glass screen. Screen hood accessory may be attached when observing parts of poor reflectivity or when operator needs to make fine adjustments or close inspection without distraction.

Stocker & Yale, Inc., Marblehead, Mass. **T-10-14**

Bolt Driving Machine

Five SEM type bolts are driven simultaneously to close torque requirement limits with the multiple-spindle bolt driving machine. The design is





TIME TO LOOK AT COSTS

You need the answers to such questions as:

"Can a TUBULAR RIVET replace a solid rivet, screw, or bolt and thereby accelerate production?"

"Would a SPLIT RIVET with a decorative head improve product appeal?"

"Should a SELF-PIERCING RIVET be used and eliminate a drilling operation?"

"Can a cold headed part such as a SHOULDER RIVET serve as a fastener and also provide a bearing surface?"

"Would a TAPPED RIVET, made to receive a screwed-on assembly, simplify field service?"

These are typical questions asked of Chicago Rivet engineers because keen competition today makes necessary re-examination of production methods. No matter how complex or how simple your fastening problem may seem to be, get the cost saving advice that Chicago Rivet engineers can give. Send blueprint or sample assembly—no obligation.

There are *Chicago Rivet* Machines that will set

1 2 3 4 5 6

Tubular or Split Rivets At a Time

Chicago Rivet & MACHINE CO.

960 S. 25th Ave. · Bellwood, Ill. (Chicago Suburb) · Branch Factory: Tyrone, Pa.

FOR YOUR FILES—Rivet catalog describing 1388 standard tubular and split rivets and 26 single and multiple automatic rivet setters.

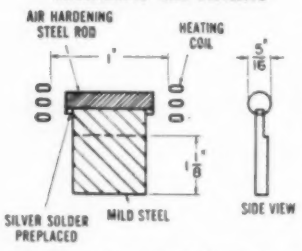
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-151

The Lepel Line of induction heating equipment represents the most advanced thought in the field of electronics as well as the most practical and efficient source of heat yet developed for industrial heating.

If you are interested in induction heating you are invited to send samples of the work with specifications. Our engineers will process and return the completed job with full data and recommendations without any cost or obligations.

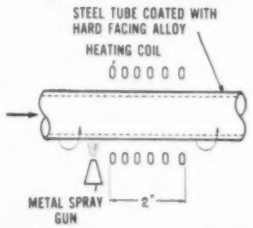
TYPICAL INDUCTION HEATING APPLICATIONS

SIMULTANEOUS HARDENING and BRAZING

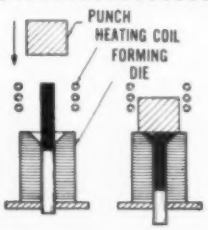


The machined and finished rod of air-hardening steel is simultaneously hardened and brazed to a mild-steel tab. Use of a purified hydrogen atmosphere and a high temperature brazing alloy permits successful hardening of alloy steels without discoloration and scaling even in the absence of flux.

DIFFUSION BONDING OF SPRAYED METAL COATINGS



Corrosion or wear resistant metal coatings sprayed on metal surfaces can be improved by heating to achieve alloying by diffusion. The drawing shows a typical arrangement for processing steel tube sprayed with hard facing alloy. Long tubes may be progressively sprayed and heated.



HEATING HIGH STRENGTH ALLOYS FOR FORMING

Uniform and rapid heating of high strength alloys (alloy steels, titanium, etc.) aids in upsetting and forming operations and also minimizes oxidation and embrittlement.

Electronic Tube Generators from 1 kw to 100 kw.
Spark Gap Converters from 2 kw to 30 kw.

WRITE FOR THE NEW LEPEL CATALOG . . . 36 illustrated pages packed with valuable information.

All Lepel equipment is certified to comply with the requirements of the Federal Communications Commission.

LEPEL HIGH FREQUENCY LABORATORIES, INC.
55th STREET and 37th AVENUE, WOODSIDE 77, NEW YORK CITY, N. Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-152

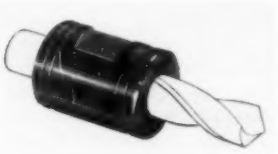
available as a multiple-spindle bolt driving head for automated production lines.

Bolts are fed by an elevator type, hopper feeder. Spindles are individually adjustable to proper bolt torque, meeting exacting production requirements. The bolt driving machine is air/electrically operated and uses available plant air.

Gray Equipment Co., 13600 Ford Rd., Dearborn, Mich. **T-10-15**

Adapter Bushings

Designed for use on all types of floating and adjustable tool holders, this adapter bushing incorporates split-type construction which clamps the entire length of the bushing. Resultant gripping power prevents tool slippage with less clamping screw pressure. Two flat spring collars on each end maintain



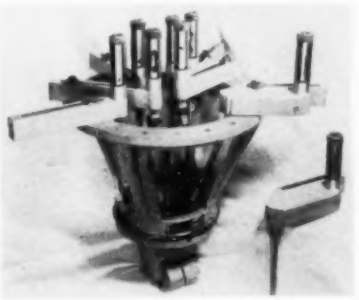
bushing alignment and provide spring tension for tool adjustment with gage. Setup time is minimized; tools are easily slipped in and out of holder for grinding and setup. When clamping pressure is removed, the tool is released. Drills can be held on flutes to permit stubbing and use of broken drills.

RingO Co., P. O. Box 863, Dayton 1, Ohio. **T-10-16**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Bracket Assembly for Drillheads

An extension spindle bracket assembly for use with Thriftmaster universal joint type drillheads, provides a 4⅛-in. extension of the maximum adjustment.

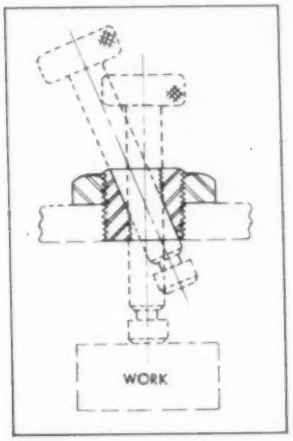


This permits drilling under and beyond the flange of the drillhead body. Full ball bearing, completely enclosed, gear driven construction assures proper operation at the same maximum speed and capacity as the standard spindle bracket assemblies. The bracket is precision machined for use with jig bored spindle locating templates.

Thriftmaster Products Corp., North Plum St., Lancaster, Pa. **T-10-17**

Insert for Clamping

A quick acting insert for clamping can be easily installed on either new or old fixtures by drilling and tapping a hole at the desired location. When the screw is tilted, it slides in and out of the fixture easily; when it is straightened, the threads engage for clamping. A jam nut or a set screw can be used to lock it in position.



A jam nut is shown to keep insert in place. A set screw can be used instead.

Inserts are available for $\frac{1}{4}$-20, $\frac{5}{16}$-18, $\frac{3}{8}$-16, $\frac{1}{2}$-13 or $\frac{5}{8}$-11 screws. They are hardened for long life, and black penetrated to prevent rusting.

Northwestern Tools, Inc., 122 Hollier Ave., Dayton 3, Ohio. **T-10-18**

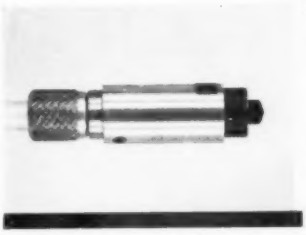
Vertical Drilling and Boring Machine

Engineered to accommodate many types of heads, fixtures, indexing tables and bases, this upright drilling and boring machine is adaptable to a variety of machining operations. It is available with capacities up to 60 hp and in 15 and 30-in. strokes. Vertical slides are 26 in. wide, 48 in. long and 20½ in. across the ways. Feed valves are cam actuated. The column can be arranged with a series of risers for a wide range of large work.

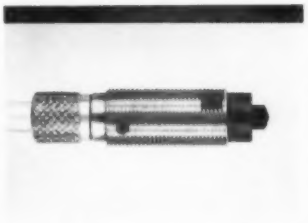
Normal automatic cycle of the machine includes rapid traverse down.

This is a Taft-Peirce Air Capsule shown with No. 9585 Height Gage Stand and Model E CompAIRator Air Gage. The Capsule is an air-actuated, direct contact measuring device that can be substituted for dial indicators in hundreds of shop inspection operations.

NEW Air Capsule Provides Low Cost Accuracy for Gaging and Quality Control



Taft-Peirce Air Capsules measure only 1½" long overall x .375" diameter. The Plain Body Type shown above clamps easily on standard shop measuring tools, or may be built into special gaging fixtures.



The Threaded Body Air Capsule is identical with the Plain Body Type, but features extra fine pitch body threads for applications where the Capsule must be critically positioned or moved slightly along its axis at frequent intervals.

From toolroom to transfer line, this new Taft-Peirce Air Capsule creates exciting new opportunities to apply high magnification, visual gaging to all kinds of close tolerance inspection work.

Clamp the Capsule on height gage or surface gage for precise work checking on a surface plate. Substitute it for dial indicators or micrometer heads when designing gaging fixtures. Take advantage of its long-wearing carbide contact point by using it as a sensing device for continuous process inspection.

A Taft-Peirce Air Capsule operates with any CompAIRator Air Gage at any standard magnification, allowing you to spread a few thousandths of an inch over a wide dial expanse, with each graduation equal to a tenth or finer. Available in short range models (0 — .004"), and long range models (.004" — .040"), with plain or threaded bodies. Also supplied with integral 90° adaptors for use where a tight mounting location might cause pinching of air hose.

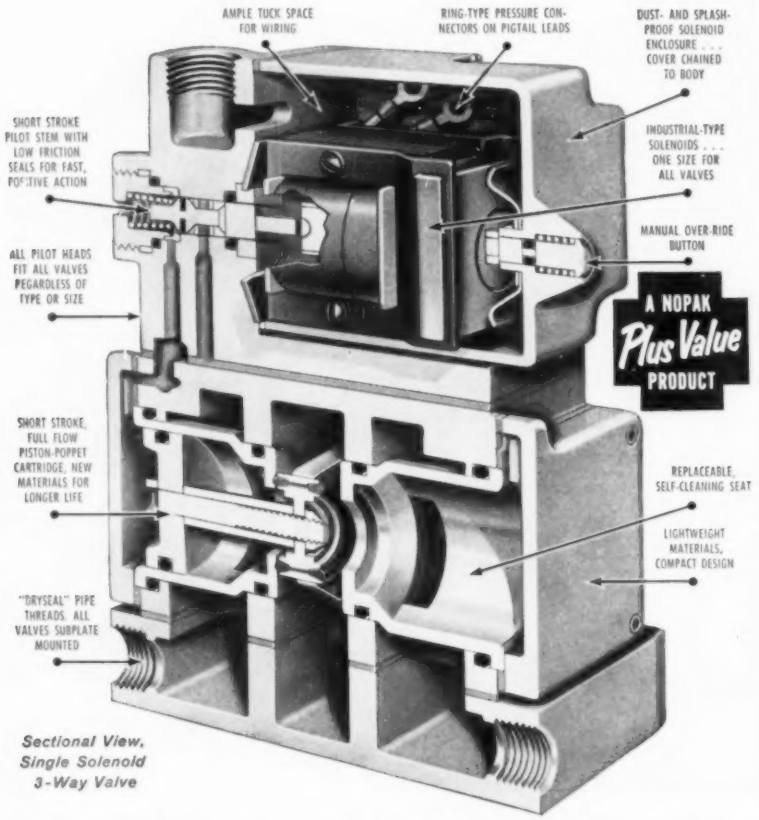
No matter what your gaging application may be, a low cost, easy-to-use Taft-Peirce Air Capsule gives you mounting versatility plus all the CompAIRator advantages of high magnification, quick response, outstanding accuracy. Write today for more information.

TAKE IT TO TAFT-PEIRCE

TAFT-PEIRCE MANUFACTURING COMPANY
WOONSOCKET, RHODE ISLAND
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-153

Nopak-matic Valves set

New Standards of Precision Control . . . in Air Cylinder Operation


AMPLE TUCK SPACE FOR WIRING
RING-TYPE PRESSURE CONNECTORS ON PIGTAIL LEADS
DUST- AND SPLASH-PROOF SOLENOID ENCLOSURE . . . COVER CHAINED TO BODY
SHORT STROKE PILOT STEM WITH LOW FRICTION SEALS FOR FAST, POSITIVE ACTION
INDUSTRIAL-TYPE SOLENOIDS . . . ONE SIZE FOR ALL VALVES
MANUAL OVER-RIDE BUTTON
ALL PILOT HEADS FIT ALL VALVES REGARDLESS OF TYPE OR SIZE
A NOPAK Plus Value PRODUCT
SHORT STROKE, FULL FLOW PISTON-POPPET CARTRIDGE, NEW MATERIALS FOR LONGER LIFE
REPLACEABLE, SELF-CLEANING SEAT
LIGHTWEIGHT MATERIALS, COMPACT DESIGN
"DRYSEAL" PIPE THREADS. ALL VALVES SUBPLATE MOUNTED

Sectional View, Single Solenoid 3-Way Valve

Only Nopak-matic Valves Give You ALL of these PROVEN Plus Values

- *"Flow Director" Pilot Head* — simplifies piping, makes desired operation possible by piping to proper port.
- *3 Pilot Heads Fit all Models* — are completely interchangeable on all valves, regardless of type or size.
- *100% J.I.C. Conformance* — a Complete Line of pilot operated Air Control Valves . . . that meet or exceed all J.I.C. recommendations . . . *at no extra cost!*
- *Fast Maintenance* — complete valve assembly can be replaced *in less than 2 minutes*, without disturbing piping.
- *Replaceable, Self-Cleaning Seats* — fast and inexpensive to replace. Poppets do not seat on valve body.
- *Fast Action* — valve shifts in less than 18-thousands of a second.

Available in ¼" thru ¾" pipe sizes for 3-Way and 4-Way operation with air, single or double solenoid pilot.

For the complete Nopak-matic Story, see Catalog 105

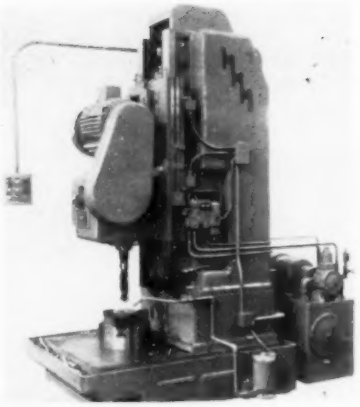
Representatives in Principal Cities

NOPAK *VALVES and CYLINDERS*

Galland-Henning NOPAK Division • 2750 S. 31st Street • Milwaukee 46, Wis.

A8-639⅓

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-154

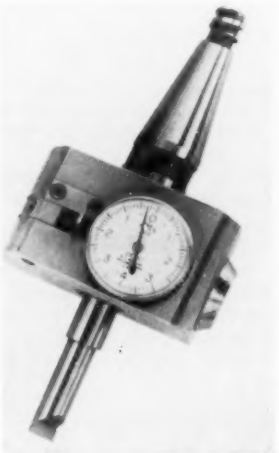


feed and rapid return, however variations of the automatic cycle are available.

The Motch & Merryweather Machinery Co., 1250 E. 222nd St., Cleveland 17, Ohio. **T-10-19**

Boring Head

The tool slide of the Micro Dial boring head can be adjusted from zero to ¼ in. off center in increments of 0.0001 in. by direct reading. A built-in dial indicator assures standardized boring operation by any operator on any vertical or horizontal boring or milling machine. After initial cut has been



made and measured, the hole can be set while workpiece is in the machine and completed with one final cut to a 0.0001 in. tolerance.

Interchangeable shanks are available for the Moore jig borer, Bridgeport ¾ capacity, Bridgeport No. 2 Morse with threaded hole, No. 3 Morse with tang, No. 4 Morse with tang, 1-in. straight shank, 5C taper shank, Lindley shank with nut and compensating ring and Sip jig borer.

P. M. Instrument Co., 10 Smith Pl., Cambridge 38, Mass. **T-10-20**

Miniature Punch Press

Designed for short run production jobs, this Mini-Line press has a controlled $\frac{3}{8}$-in. stroke and can be operated from both sides, either right or left handed. By resetting the two-position handle, it also can be operated forward or back.

Accessories for the $3\frac{1}{2}$-lb press, which measures 7 in. in height, include a set of 10 round punches in sizes from

0.020 to $\frac{1}{4}$ in., pedal kit for foot operation, die set and an eyelet set in $\frac{1}{16}$, $\frac{3}{32}$ and $\frac{1}{8}$-in. sizes. Special tooling and mounting plate for clamping to bench are also available on order.

The MagneTec Corp., 11785 W. Olympic Blvd., Los Angeles 64, Calif. **T-10-21**

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Measuring Devices

The Air-O-Test air comparator gage, is built to withstand shop handling,

while giving consistent, accurate readings in split-tenths of a thousand.

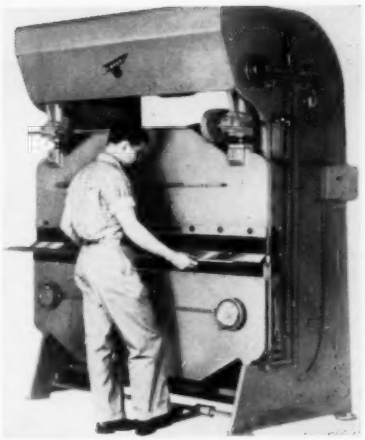
The device can be used with simple setups on cylindrical grinders to show that work has been properly positioned and clamped. It may also be used on lathes, surface-grinders, etc. for sizing.

Sperman Metal Specialties, 21991 E. 21st St., Brooklyn 29, N. Y. **T-10-22**

Press Brake

This 25 ton, six-foot bed, hydraulically operated press brake incorporates an adjustable stroke and a dual-speed operating cycle with power work stroke. Stroke adjustment feature of this Di-Acro Hydra-Power press brake Model 16-72, enables the operator to preset the stroke of the ram (in less than 15 seconds) to the narrowest possible opening for each job. Thus an efficient production rate can be maintained on any job because the rate of strokes per minute is increased as the stroke or opening is decreased.

The dual-speed operating cycle with power work stroke feature on the press brake automatically provides two speeds



CIRCLE R precision underwrites your precision by holding within very close tolerances, where required — adding precise performance to such extraordinary cutting tools as these shown above. In automation, especially where cutting is extra tough, you get longer runs, less down time, fewer stoppages for re-sharpening.
Consult your Circle R specialist.

BURBANK	INDIANAPOLIS	PHOENIX
CHICAGO	MILWAUKEE	PITTSBURGH
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HACKENSACK	——	WESTBURY, L. I.

637-7

SEND FOR CATALOG O

METAL SLITTING SAWS
COPPER SLITTING SAWS
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CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS
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CIRCULAR TOOL CO., INC.
PROVIDENCE 5, RHODE ISLAND
Specialists in Circular Cutting Tools Since 1923

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to the ram during each operating cycle. The ram travels at fast speed to a preset point just above the work, goes through the work part of the stroke in slow speed (with full pressure) and then resumes fast speed on the return portion of the stroke.

A combination hydraulic and mechanical system is used to power the machine. Basic source of power is through a hydraulic system, which has two oscillating rotary type cylinders of different sizes mounted on the same shaft at the top of the machine. When force is aplied to the cylinders, resulting pressure transmitted to the work is always equal.

Length of stroke is controlled by rotation of the hydraulic cylinders. Accurate duplication of work is assured because the ram always works off the bottom of the stroke. Adjustment of the ram need be made only when changing dies or material thicknesses is necessary.

Because of a constant flow of power through the hydraulic system there is no possibility of jamming. Sensitive inching of the ram as well as instantaneous starting, stopping and reversing of the ram also are possible. An adjustable relief valve can be preset to apply only maximum tonnage required to bend or punch material of a given size.

O'Neil-Irwin Mfg. Co., 625 Eighth Ave., Lake City, Minn. **T-10-23**

USE READER SERVICE CARD ON PAGE 167 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Universal Chuck

This universal chuck for cylinder grinding wheels automatically centers the grinding wheel with the spindle as the jaws of the chuck tighten against the grinding wheel, which is always in balance. There is no possibility of off-center chatter or off-center vibration in the spindle.

Jaws spaced around the grinding wheel are tightened by turn of a chuck

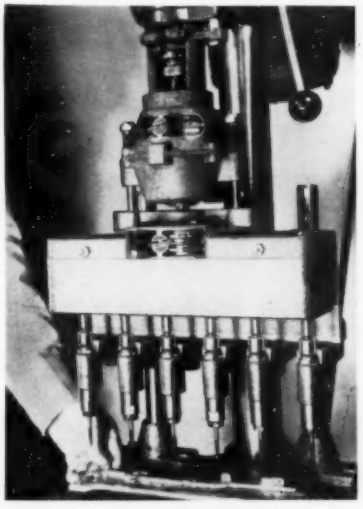
key, with equal pressure exerted on all jaws simultaneously. Grinding wheels can be changed in a matter of seconds. Rough and finish wheels may be alternated quickly and selected grit sizes may be substituted as desired. All moving parts, including jaws, are easily removed or replaced.

Chucks are available in sizes to accommodate all standard wheels from 6 to 20 in. diameter on any machine using a cylinder wheel.

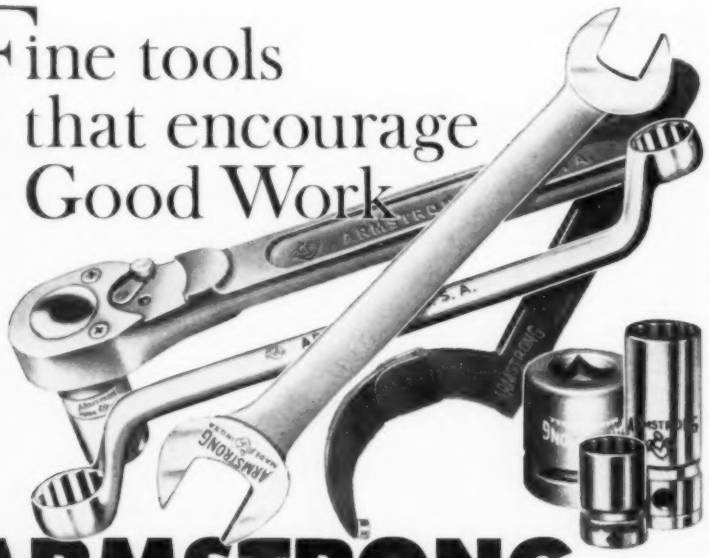
Lindgren & Sons Machine, Inc., Chicopee Row, Groton, Mass. **T-10-24**

Multiple Spindle Head

Straight-line multiple drilling and tapping head has six adjustable universal ball joint type spindles. The head, called the Knuckle-head 1000,



Fine tools that encourage Good Work



ARMSTRONG WRENCHES

If you don't know your local ARMSTRONG Distributor, we will send you the names of those in your area.

An ARMSTRONG Wrench feels right—is balanced. It goes over nuts or screw heads easily, grips firmly without sloppiness, won't round corners—because openings are carefully machined to correct sizes. It's safe, strong beyond need without clumsy bulk—because of superior design and selected steels, heat treated to proper degree of hardness and tensile strength. It's quality finished, ARMALOY (alloy steel) Wrenches in chrome plate with heads buffed; HI-TEN (carbon steel) Wrenches in baked-on gray enamel with heads ground bright . . . all plainly marked for size. All are uniformly excellent tools manufactured under strict quality control, by modern methods, with modern equipment in a modern tool plant . . . 1537 different industrial sizes and types —single wrenches, or sets in metal cases, boxes or rolls . . . each a quality tool. Armstrong Wrenches are "Fine tools that encourage good work."

ARMSTRONG BROS. TOOL CO. 5257 W. ARMSTRONG AVE. · CHICAGO 46, U.S.A.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-156

is capable of either drilling or tapping a broad variety of hole patterns without a reversing motor.

Designed to operate in any position on any drill press, drill unit or tapping machine, the heads will run at top speed in either direction without vibration regardless of spindle location. Spindles can be located anywhere within a 3-in. diameter with a $1^{5}/_{16}$-in. minimum center distance, while the unit is running.

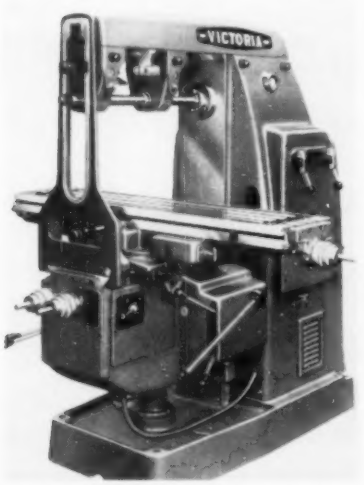
Lightweight and compact, the gear case provides a 1:1 grooved precision type ball bearing thrust for each spindle. Guide bushings are provided in the gear case to permit the use of guide rods for rigidity and alignment.

The heads are available with either adjustable locating arms or aluminum templates, jig bored to requirement.

Etco Tool & Machine Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y. **T-10-25**

Milling Machine

This Victoria U2 Rapidmil milling machine incorporates backlash eliminator, mechanical overloads, one-shot lubrication for power and rapid traverses in all directions. Two ranges of speeds provide 30-1500 rpm; feeds extend from 0.65 to 21.5 in. Nickelchrome hardened and ground gears run on splined shafts.



Bentley Industrial Corp., 41 E. 42nd St., New York, N. Y. **T-10-26**

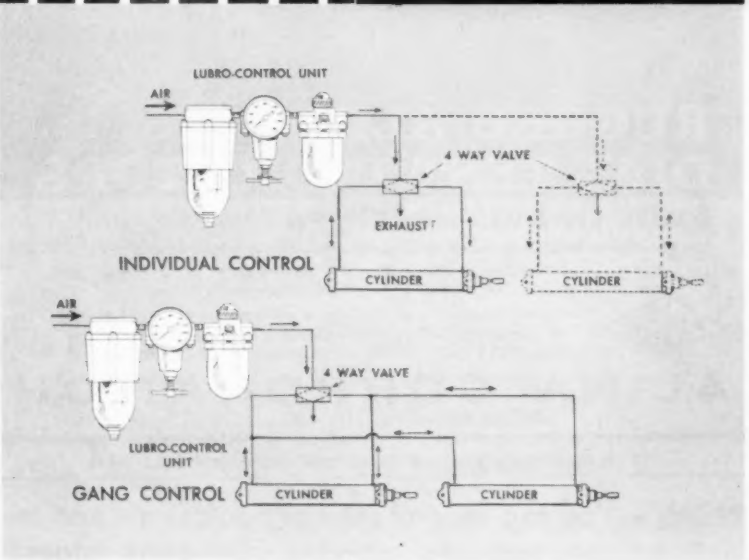
Toolholder

Universal-positioning Uni-Max tool holder holds any $^{3}/_{16}$ to $^{1}/_{2}$ in. tool bit or boring bar in any horizontal work position on lathes, planers, shapers, slotters or other machines. Its design provides accurate positioning for carbide-tip as well as high-speed steel cutters; there

Norgren

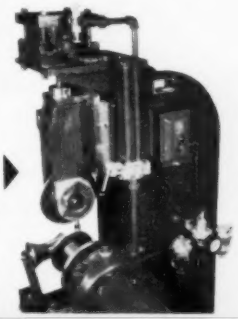
MICRO-FOG LUBRO-CONTROL UNITS

IMPROVE AIR CYLINDER PERFORMANCE



• Increased Cylinder Life
• Lower Maintenance Costs

For top cylinder performance, proper air filtration, regulation and lubrication are vital. The filter removes abrasive solids and corrosive liquids from the air and the regulator provides accurate, unvarying air pressure. Norgren MICRO-FOG, in the stream of air that powers a cylinder, provides ideal lubrication by automatically applying just the right amount of lubricant. Results: better cylinder performance, no scored cylinder walls, no damaged packing, lower maintenance and replacement costs. A single MICRO-FOG Lubro-Control Unit can provide proper compressed air processing for multiple cylinder operation.



Without the compressed air filtration, pressure regulation and lubrication provided by the Norgren unit, it would be impossible to get the close control needed in the operation of this pipe cutting machine.

If it's Norgren... It's Dependable.

For complete information, call your nearby Norgren Representative ...or WRITE FOR DESCRIPTIVE LITERATURE

C. A. NORGREN CO.

3447 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

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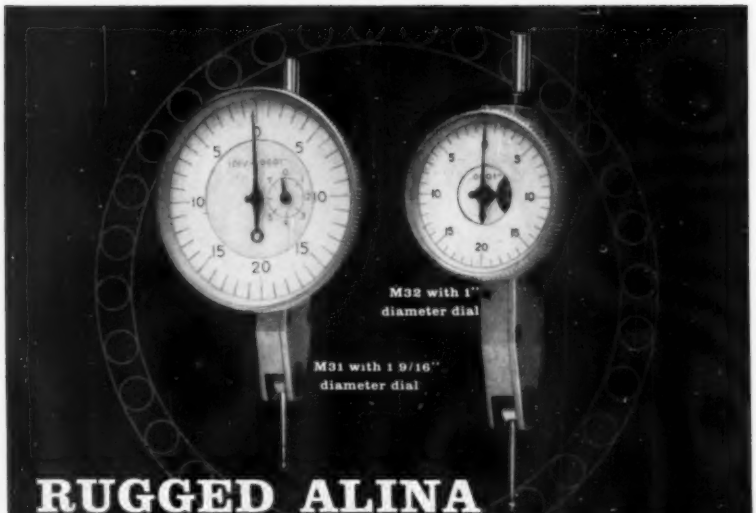


RUGGED ALINA DIAL TEST INDICATORS

built-in ball bearings

for greater sensitivity—reduced pressure—improved accuracy

- Jeweled • Shock Proof • Range .032" • Graduated .0001"
- Reading 0-20-0 • Fully reversible contact point

Available with a wide variety of rectangular or round shanks.

The instruments shown here are part of a complete line of precision DIAL TEST INDICATORS of all types — Write for brochure!

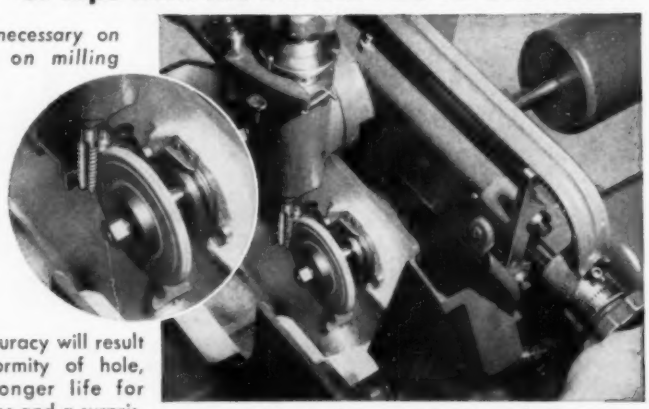
ALINA CORPORATION

122 East Second St., Mineola, L.I., N.Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-158-1

NOW – You can control rake or hook angle and insure accurate indexing of cutting edges* of taps with the BLAKE FLUTE GRINDER.

**Just as necessary on taps as on milling cutters.*



This accuracy will result in uniformity of hole, much longer life for your taps and a surprising savings in tap costs.

Keep it sharp — Make 1 tap do the work of 6 with The Blake Flute Grinder.

Write for bulletins on BLAKE Tap Sharpening Machines

EDWARD **BLAKE** COMPANY INC.

MANUFACTURERS OF FLUTE AND CHAMFER GRINDERS

450 CHERRY ST., WEST NEWTON 65, MASS.

Exclusive Distributors of:

Black Diamond Drill Grinders • Surface Finish Standards • Worcester Drill Grinders

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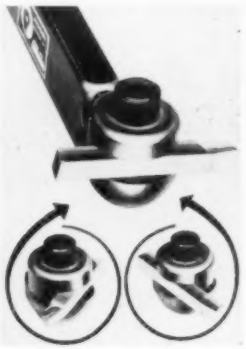
is no need for special holders for each type of cutter.

The rotating clamping cap has annular serrations that heel precisely with radial serrations on the shank for a grip with no lateral movement possible. Straight serrations on the tool bit slot and the cap screw with grip head and hex socket give added holding strength.

The tool is held parallel to the shank of the holder and thus presents a com-



paratively large body of metal to absorb heat generated at the cutting edge of the tool. This substantial body also supports the cutting tool to operate without chatter.

Three sizes, 5, 6 or 8 in., will handle all tool bits or boring bars from 3/16 to 1/2 in., round or square.

Maxwell Industries, Inc., 493 E. Fifth Ave., Ashtabula, Ohio. **T-10-27**

Magnetic Chuck and Automatic Control

A precision grinding team, made up of the Selectron automatic chuck control and Power-Grip magnetic chuck, provide adjustable holding power and a "demag" cycle that eliminates all residual magnetism. Thin or fragile workpieces may be removed easily from the chuck without distortion. Consistent

repetitive accuracy is obtained because the "demag" feature permits swift and thorough chuck cleaning. The 24-volt circuit keeps the chuck cool; neither the chuck nor the workpiece heats up. The operator quickly selects the holding power so that each job may have the correct amount for sure, safe holding without distortion.

The Power-Grip magnetic chucks and Selection controls are available in a range of sizes for most surface grinding applications in both direct control and remote control models.

The DoAll Co., Des Plaines, Ill. **T-10-28**

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Nibbler

All types of corrugated metals, as well as metals with asbestos or pitch coating can be cut with this nibbler without clogging the machine.

It provides a simple punch and die operation and leaves a finished, smooth edge when cutting. An operator's fingers cannot come in contact with the

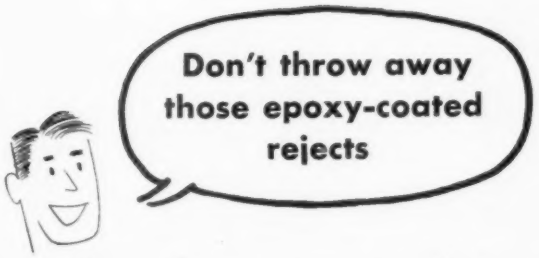
punch because it is set well back in the nose block. For safety, cut pieces of metal drop directly down.

The tool is manufactured in both air-powered and electric models. It is made in five models and can be vise-mounted for bench work or, because of its 13-lb weight, can be used portably.

Fenway Machine Co., 3107 N. Broad St., Philadelphia, Pa. **T-10-29**

Drilling and Checking Fixture

This Roto-Check can be used both as a checking fixture and as a grinding fixture for grinding any combination of slots, squares, hexagon etc. It is a useful accessory for jig grinder, jig borer, or for boring or drilling holes in plates on bolt circles 1, 2, 3, 4, 6, 8, 12 or 24 combinations. The devise also can be



Here's a new paint stripper that will save them

Do you scrap perfect metal parts that have been imperfectly coated with epoxies, vinyls, polyesters and other hard-to-strip paints or lacquers?

In the last few months, users of Oakite Stripper S-A have eliminated many such losses. Here's what some of them say about it:

CALIFORNIA: An aircraft manufacturer tested many strippers on an epoxy designed to resist attack by hydraulic fluid. Finally found that Oakite Stripper S-A is "the only one that safely strips this paint from anodized aluminum."

NEW YORK: A camera maker coats flash bulb reflectors with black vinyl paint outside and aluminum paint inside. "Stripper S-A is the fastest ever used on our rejects."

OHIO: A maker of toy pistols had trouble stripping alternate coats of lacquer and metallized aluminum. Now "Stripper S-A does it amazingly fast and remetallizing is completely satisfactory."

CALIFORNIA: A producer of metal furniture uses Stripper S-A to remove clear epoxy from plated parts. Chemist says "This is the best stripper on the market."

ALABAMA: A hardware maker had trouble stripping lacquer from brass door knobs. Oakite Stripper S-A now does the work in "less than ⅓ the time taken by any other stripper."

NEW YORK: A manufacturer of business machines tested several strippers on various finishes on steel and aluminum. Verdict in favor of Stripper S-A was: "It's doing a wonderful job."

CONNECTICUT: A maker of brass lipstick shells has found that "Stripper S-A quickly strips epoxy lacquers from rejects and heavily coated work spindles."

CALIFORNIA: A missile maker reports that "Stripper S-A is doing a fine job stripping vinyl from stainless steel and titanium."

FREE Write Oakite Products, Inc., 58 Rector St., New York 6, N. Y., for complete information on Oakite Stripper S-A.

At The Metal Show Visit Oakite Booth 1230

OAKITE

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In our 50th year

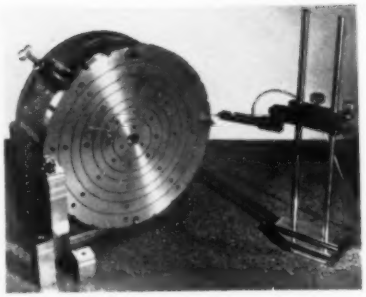
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-159

used for grinding radii and contours.

Engineered for checking any angles, Roto-Check can be set up horizontally or vertically, and checks out square. Locating ball 5 in. on center for setting up any angle desired.

It can be motor driven or is available without the motor for hand operation. Tooling bolts permit checking any angle.

The unit is manufactured in two models for close work and for average work: precision model No. P-500 will hold a tolerance of 0.0003, while standard model No. S-24 affords a tolerance of 0.002 in.

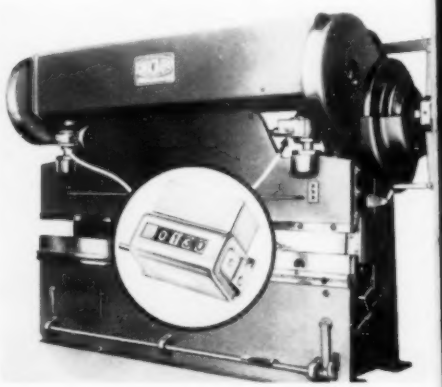


M & M Tool & Mfg. Co., 1124 E. 3rd St., Dayton 2, Ohio. **T-10-30**

Counter for Press Brakes

A Rotary Productimeter, equipped with a limit switch, can be incorporated on press brakes for a variety of forming work and punching jobs. The switch is sealed positively against oil and dust seepage.

Illustrated on a Dreis & Krump press brake, two counters are used as ram adjustment indicators, one for each adjustment screw, reading in 0.001 in. They perform two functions by indicating position of the ram adjustment, and



limiting ram adjustment at its extreme up and down travel. The limit switch feature prevents the ram adjustment screws from jamming tight on the "up" movement, or dropping out in the "down" direction.

Since the ram adjustment is movable to anywhere from 0 to 5 in., the machine will accommodate a variety of dies. After specific settings are made, a reading of the counters is taken and recorded. When the job comes up again the operator has only to refer to the reading to get the correct setting.

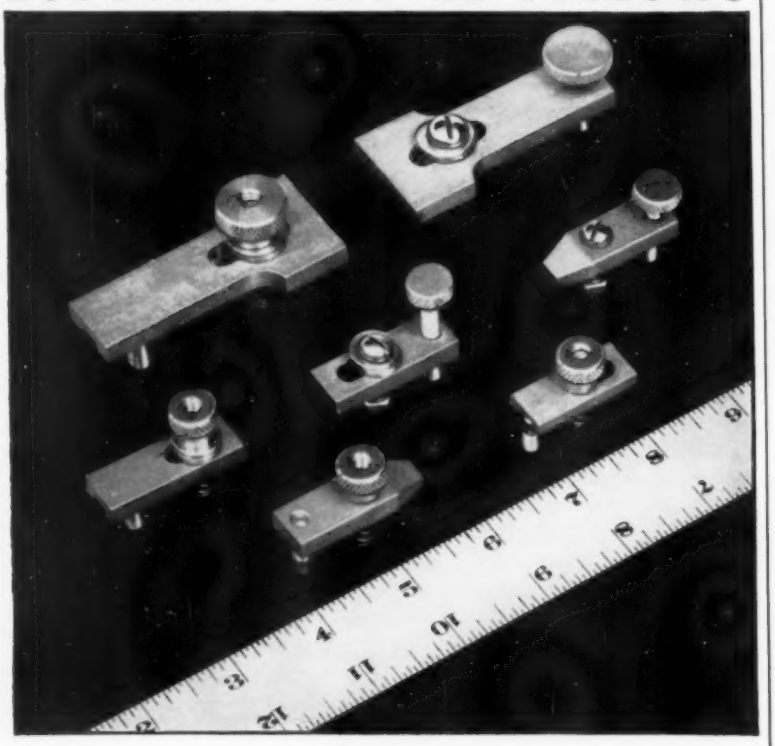
Durant Mfg. Co., 1972 N. Buffum St., Milwaukee 1, Wis. **T-10-31**

Hydraulic Cylinder

Powrdraulic hydraulic cylinder has a pressure tightening tube O ring seal located on the outside diameter of the tube, fully confined between the tube and cylinder head. Because the seal is on the tube OD, minute expansion of the tube under pressure squeezes the O ring, increasing tightness of the seal. Thus, the seal will remain tight at all pressures.

The Powrdraulic cylinders are rated at 2000 to 3000 psi nonshock and have

LODDING'S LITTLE FELLOWS



- Non-magnetic - Stainless steel type 303
- Tensile strength 90,000 p.s.i.
- Heat resistant - austenitic series (not affected by heat treatment with high resistance to scaling and distortion)
- Corrosion resistant (high resistance to many corrosives including acids)

More than 85 details and 30 assemblies available immediately from stock

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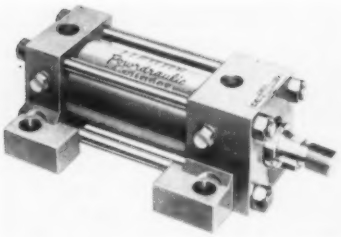


a broad safety margin. Bore sizes range from 1½ through 8 in. Thirteen basic models and a choice of rod sizes are available. They have industry standard mounting dimensions and conform to JIC recommendations. Because all mountings are welded, accurate alignment and squareness of mounting are assured.

Hanna Engineering Works, 1765 Elston Ave., Chicago 22, Ill. **T-10-32**

Rust Preventative

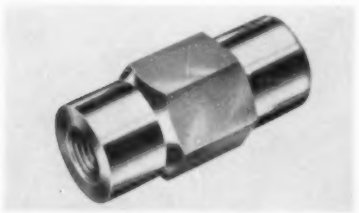
An industrial coating, Arrust, is an oil coating fortified with a rust inhibitor which provides rust prevention on all ferrous metals. Easy to apply, it can be used directly over firm rusted surfaces without peeling or flaking, and acts as both a prime and finish coat. Except for severely rusted surfaces, only one coat is necessary. One gallon of Arrust will cover 300 to 400 sq ft of surface with excellent hiding properties.

It stops rust by penetrating and combining with oxidized material to form an impervious, elastic coating. It is also highly resistant to moisture, atmospheric conditions, acids, oils and most chemicals. It is supplied in tile red, medium gray or jet black, or in other colors on special order.

Arted Co., 141 W. 53rd St., New York 19, N. Y. **T-10-33**

Air Bleed-Off Valve

Air is eliminated by hydraulic circuits by this air bleed-off valve, which automatically vents air to tank, assuring adequate pump priming and efficient circuit operation. The valve operates in hydraulic circuits under pressures up to 5000 psi.



Its dimensions are $2\frac{3}{8}$ by 1 in. hex, and it is available with ¼-in. NPT or

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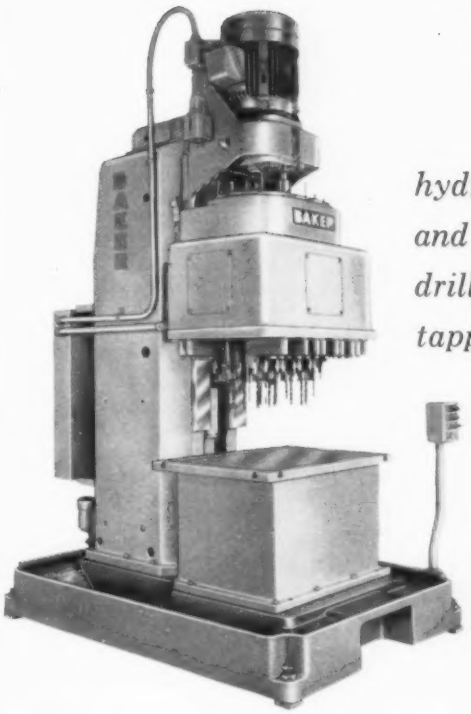
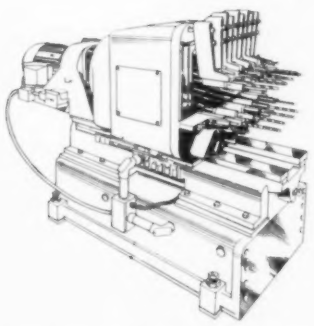


hydraulic vertical and horizontal drilling and tapping machines



WITH NEW STANDARD ADJUSTABLE SPINDLE HEADS

They're here! The new full line of standardized Baker basics—most versatile machines available. Advanced design assures minimum maintenance, permits fastest retooling using standard components. Write for new catalog and name of nearest Baker representative.

BAKER BROTHERS, INC., TOLEDO 10, OHIO

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-161

9/16 in.-18, straight threads.

The air bleed-off valve is installed in the pump discharge line—ahead of all other components—with a "T" connection. It remains open as long as system pressures remain low and permits air to flow to tank. When air has been dissipated, the initial surge of hydraulic fluid automatically closes the valve, which remains closed until the pressure drops.

Denison Engineering Div., American Brake Shoe Co., 1160 Dublin Rd., Columbus 16, Ohio. **T-10-34**

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Seal

A static hydraulic seal is designed to deform with 25 to 175 lb-ft of torque to become an integral part of fittings. Tests indicate leakproof sealing through −360 to +1200 F depending on use of aluminum, stainless steel or Inconel-X.

and from 0 to 10,000-plus psi. No presetting tool is required. This Natorq seal accepts fitting discrepancies; fittings can be disassembled repeatedly.

Navan Products Inc., International Airport, Los Angeles 45, Calif. **T-10-35**

Cutting Compound

Liquids and metallic solids are combined in a cutting compound which has film strength necessary to carry away chips in large volume and prevent build-up or welding on the cutting edge. At the same time, the compound's heat conductivity provides temperature control at heavy metal removal rates.

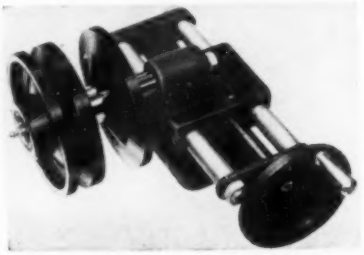
The compound forms a long lasting but easily removed protective coating over the machined surface, which helps prevent corroding action caused by ordinarily encountered oxidizing agents.

The new cutting compound can be used in standard coolant piping and pumping systems of machine tools without need for mechanical alterations.

Commonwealth Engineering Co. of Ohio, Dayton, Ohio. **T-10-36**

Adjustable Speed Pulley

Almost any ½ or 1-hp constant speed motor can be equipped for an extremely wide range of speeds with this adjustable-speed pulley mounted on an adjustable control base. The pulley is a double variable-pitch unit which automatically adjusts driver and driven



sheave. Moving the countershaft towards the driver reduces driven speed; movement away from the driver increases driven speed. A few inches of adjustment makes the complete speed range available.

Two models of the high-ratio pulley are available. The fractional to ½-hp unit has a ratio of 6:1 with PD varying from 1.875 to 4.60. The fractional to 1-hp unit has a 7.2:1 ratio with PD from 2.40 to 6.50.

Faces of the pulley are made from plastic with special additives for long life, economical replacement and minimum maintenance. Handwheel adjustment gives precise settings on the control base.

The sturdy, lightweight unit can be installed easily in a variety of drive configurations.

Lovejoy Flexible Coupling Co., Dept. TED, 4949—H W. Lawe St., Chicago 44, Ill. **T-10-37**

Universal Lead Tester

Ability to check the lead of straight or taper threads, internal or external threads, and taper of threads or cylinders are combined in Model A electromechanical universal lead tester.

Designed for use in inspection rooms and gage laboratories the high-precision gaging machine can check internal threads ranging from 1¼ to 16 in. diameter, and external threads ranging

from 0 to 16 in. on work as heavy as 500 lb.

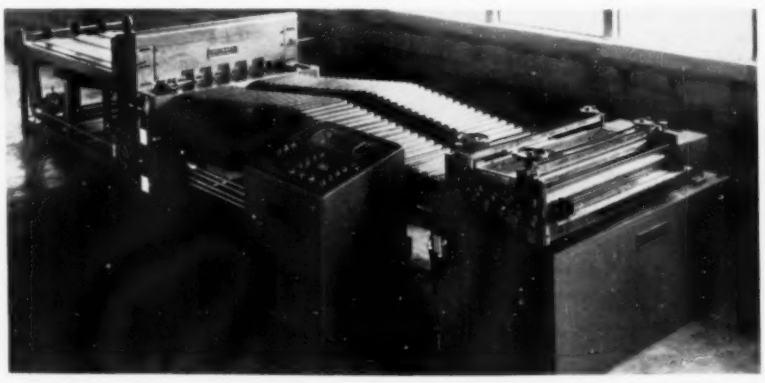
Direct readings are made to 0.00002 in. for lead, and to 0.00001 for taper by means of the Electrolimit gaging principle incorporated in the machine. Interchangeable gaging spindles and ball points are provided to check a full range of thread pitches.

Pratt & Whitney Co., Inc., W. Hartford 1, Conn. **T-10-38**

Decoiling–Shearing Lines

Automatic decoiling and shearing lines are available for automatically converting steel, stainless steel, aluminum and other metal coils to sheets by decoiling, straightening and shearing cut lengths from minimum of 3 in. to any maximum length.

Simplest form of the lines comprises a coil reel, straightening roll, hump table, shear and conveyor; all units are wired into a console for electronic measuring and central control of line.



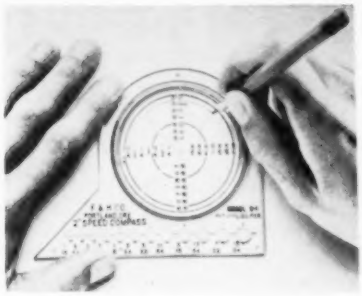
An edge trimmer also can be supplied to cut exact widths as well as lengths; other items such as coil racks, coil lifts, scrap choppers, levelling rolls and stackers can also be included. Lines are offered in widths up to 6 ft and in metal thickness to 10 ga.

Secrest Machine Co., 1507 M. St., N. W., Washington 5, D. C. **T-10-39**

Template Compass

A 2-in. speed template compass permits the draftsman to make perfect circles from ¼ to 2 in. in diameter. An additional row of template holes from 1/16 in. diameter to 15/64 in. affords a choice of 69 diameters.

The Draftsman's Model, for use with a drafting pencil or 0 pen, is graduated in 1/32 of an in.; the Student Model for



general use with regular pencil is graduated in 1/16 in.

Ball-bearing action in the compass rim assures accurate concentric circles; measurements are automatic. Circles of different sizes can be made while the device remains stationary.

Identifying numerals are indented so they cannot wear off.

F. & H. Mfg. Co., 817 N.W. 23rd Ave., Portland 10, Ore. **T-10-40**

Tracing System

A hydraulic contour following system can be supplied with new roll lathes or adapted to existing lathes. The basic tracing system makes possible coordinated, positive feed control to the two slide motions regardless of cut load or feed direction. It is also possible to cut square shoulder passes with complete control.

The tracer feed system is powered by adjustable displacement pumps in a closed, supercharged circuit to the actuation means for each slide. Longitudinal motion is provided by hydraulic motor and ball screw; cross-feed motion is by rodless cylinders actuating an antifriction mounted ram.

Template and controls are conveniently located. The arrow indicator on the operator's control panel locks-in as soon as the stylus contacts the template, indicating direction of feed. The arrow can also be used for steering the tool point for setup and general maneuvering between cuts.

A cut depth limit device provides the means for progressively removing stock at any desired depth of cut between the sides of a pass groove. On roughing cuts, the operator resets the depth limit at each side of pass and reverses the feed at will.

Blaw-Knox Co., 300 Sixth Ave., Pittsburgh 22, Pa. **T-10-41**

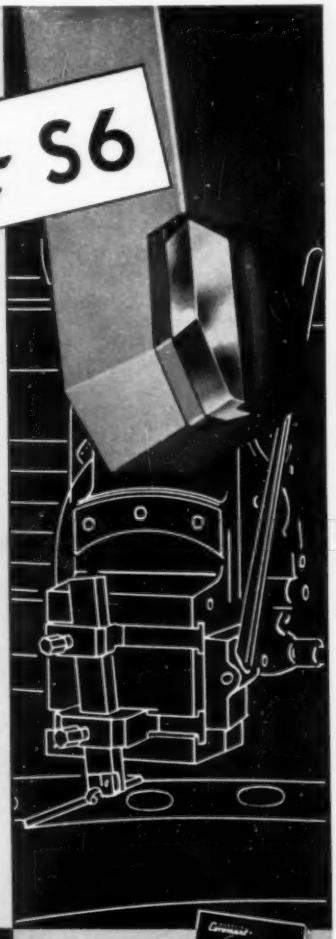
Die Tryout Presses

A 300-ton mechanical die tryout press incorporates a slide that rotates up to 240 deg from its normal position, permitting safe, full accessibility to the die. Less than a minute is required to return the slide and upper half of the die to running position. The die can then be tried or a production run made in this same machine. Dies can be loaded into the press with an overhead crane and need not be removed until the desired stamping is produced. The

There's NO Equivalent—

Coromant S6

SANDVIK To Coromant's New Shock-Resistant CARBIDE Grade S-6



Sandvik Coromant's new S6 carbide is a unique combination of extreme toughness and high wear resistance. It's a super carbide that opens the door to lower machining costs on the toughest, tool-killing applications. These facts give it the ability to handle —

- planing, milling and turning operations on cast steel, heat resisting and stainless steels, scaly materials.
- interrupted cuts, feeds over 1/32".

Phone or write your nearest Sandvik Coromant office for further details.

55-132

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Send For This FREE CATALOG AND CARBIDE TOOLING GUIDE

Covers the complete Coromant line of carbide tools, blanks and inserts, tool holders, combination cutters, end mills, twist drills and scrapers. Also has many useful tables, diagrams, grade recommendations, etc. in technical data section.

FROM ORE TO FINISHED PRODUCT WITHIN THE SAME COMPANY

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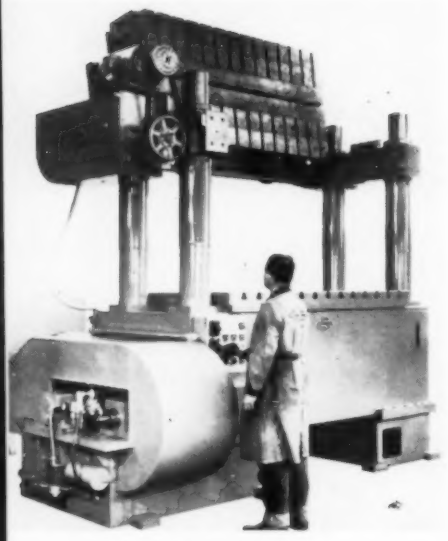


Alpha S2-300-84-48 two-point, 4-column, double-back-geared underdrive press has an 8-in. slide stroke. Shut height—stroke down, adjustment up, bed to slide is 36 in. Strokes per minute, with adjustable speed drive, range from 10 to 30 strokes. Slide can be rotated 240 deg from its normal operating position. When the slide is returned to its normal position for running the press, the locking pins must be engaged before the clutch control circuit is operative.

Alpha Press & Machine, Inc., 9381 Freeland Ave., Detroit 28, Mich.

T-10-42

Gun Drilling Machine

Standard gun drilling machine holds critical tolerances for hole concentricity, squareness, finish and size. The machine can be adapted for various depths, and for various size holes, with a small amount of fixturing. One 16 spindle installation is presently drilling 0.296 in. diameter holes, 16½ in. long, in automatic transmission output shafts, at the rate of 360 pieces per hour.

Except for load and unload, entire operation is automatic. Automatic load and unload can also be provided.

The cutting tool is driven by a torque drive adapter, having a contact switch to protect the cutting tool from breakage. If the gun drill is dull or improperly ground, creating excessive torque, the torque drive will "rapid return" the drill to the back position. It also stops the rotation of the spindle and cuts off the supply of oil.

During operation, cutting oil is delivered under pressures from 75 psi to 1500 psi to the rear end of the rotating spindle and thence forced through the spindle shaft into the drill center where it serves as both a coolant, and a chip flusher at the tip of the drill.

The standard unit will handle two parts simultaneously, and is capable of

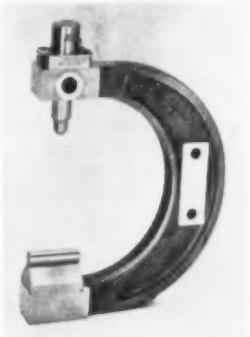
drilling holes from 0.187 to 0.750 in. in diameter. Spindle speeds range from 2000 to 8000 rpm; feed rate varies from 0.0001 to 0.010 ipr, and feed stroke can be adjusted from 1 to 12 in. Maximum stroke, for tool change, is 20 in. Longer strokes, and larger drill sizes are available in other models.

Crescent Tool & Machine Co., Inc., 25125 W. Outer Dr., Melvindale, Mich.

T-10-43

Gear Gage

Pitch diameter of gears, splines and worms can be checked fast and accurately by this gage which has a me-

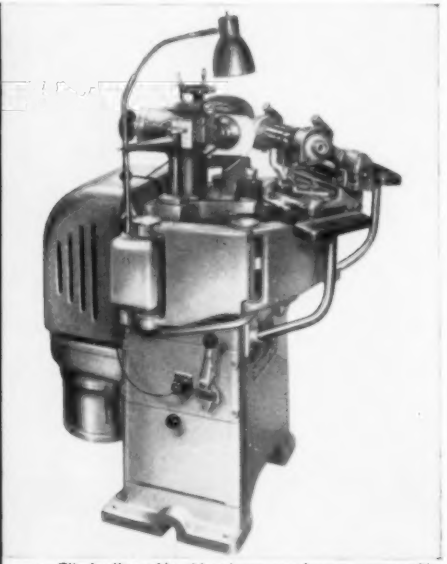


chanical amplifier mounted on the body to amplify measurements five times. A step on top of the amplifier unit shows immediately whether or not minimum or maximum tolerances are exceeded. To assure precision the steps are

OERLIKON

FS 21 FORM AND CUTTER GRINDER

The FS 21, with its well-selected accessory equipment, is an exceptionally flexible machine which allows to sharpen edge pointed as well as cam-relieved cutters with a correct clearance angle and an accurate profile. The scope of the machine comprises right and left hand, profiled, taper and cylindrical cutters, straight or spiral fluted, with positive or zero rake angle, arbor and shank type, as well as reamers, sinking cutters etc.



- Elimination of heat treat warpage by accurate profile grinding.
- Profile and teeth always exactly concentric.
- Possibility of modifying the profile at any time.
- Possibility of selecting and modifying the clearance angle according to the material to be machined.
- Long tool life due to optimum cutting conditions.

Write for detailed information and prices to:

Oikon Corporation Machine Tool Division
13823 West Eight Mile Road Detroit 35, Michigan
(Some exclusive territories still available)

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-10-164

ground with a tolerance of +0.0000 and −0.0005. The easy-to-use gages are available for practically all size gears.

Holmes Gage & Development Corp., 537 Bonham Ave., Columbus 3, Ohio. **T-10-44**

Profiling Cutters

High-speed steel form relieved cutters are available for profiling hydraulic port contours and flareless tube connector internal profiles in a single pass. Both models are equally suited for aluminum or steel applications. They are available from stock in a complete range of sizes.

The tools are manufactured to AND and MS specifications. The AND 10050 cutter is available with a replaceable plain pilot or a replaceable high-speed steel reamer pilot. When the high speed steel reamer is used the correct thread truncation is cut at the same time the form is produced. The MS 33514 tool is produced to the upper limits of the part tolerance in order that the user may get maximum regrind life. Both models also are available as carbide tipped tools.

Craig Tools, Inc., 133 Lomita St., El Segundo, Calif. **T-10-45**

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Level and Angle Finder

This combination level and angle finder provides instant reading in a wide range of application. Temperature extremes have no effect on the

device, which is shockproof, waterproof and nonmagnetic.

The level and angle finder has a symmetrically divided protractor with a red pointer, designed for fast, easy reading. A compensating screw allows the setting of angles in relation to other angles with minimum possibility of error.

Quickly "zeroed-in," it provides direct readings.

Research Engineering and Sales Co., 1014 Longfellow, Royal Oak, Mich. **T-10-46**

CONTROL the finish ...and the **COSTS** with the surfindicator

No over-finishing . . . no under-finishing with the Brush Surfindicator. Weighing only 15 lbs. and ready to be plugged into any 115 volt outlet, it provides on-the-job instant surface measurement. Controlled finish is now practical—inexpensive—and extremely profitable.

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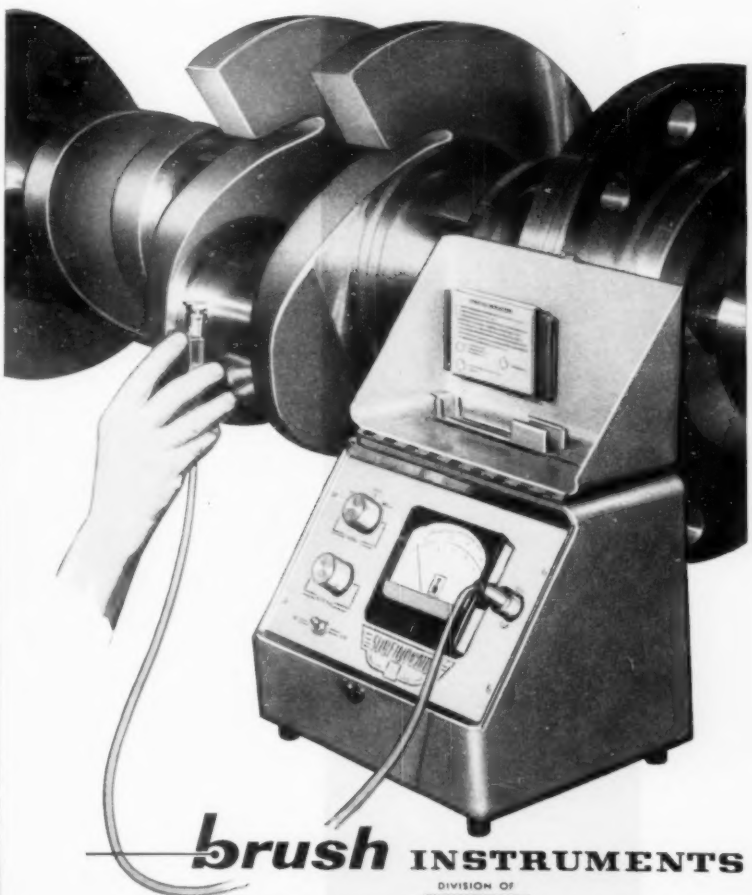

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DIVISION OF CLEVITE CORPORATION
3405 PERKINS AVENUE CLEVELAND 14, OHIO

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NOW AVAILABLE FROM STOCK

. . . Kennametal* Boring Bars with adjustable and interchangeable heads

No need for adjustable head on machine... adjustment is made on the tool itself

Featuring the Kendex* "throw-away" insert principle, Kennametal Adjustable Boring Bars are now available with two and three heads that can be used interchangeably on two different styles of bars. Both bars are made in seven diameters, ranging from 1 to 2½ inches. One style is made with a solid steel shank, while the other utilizes the exclusive K-Bar construction to provide greater rigidity for high precision boring jobs.

The Kennametal Adjustable Boring Bar is ideally suited for all types of chucking machines, semi-automatic lathes and precision boring applications on many other machines. This design brings new ease of simple, accurate adjustment, without sacrificing rugged strength or rigidity. A unique gib, plus the improved method of anchoring the cutting head to the bar give maximum strength. At the same time, the fine, precision adjustment permits simple setting and positive holding of close tolerances.

Standard Kendex throw-away inserts provide the many mechanical advantages and cost-reducing features of Kendex tooling. The snug fitting shim and chipbreaker leave no gaps in which chips can jam. For maximum support and durability, both are "all carbide" . . . as strong as the insert itself.

Get more information on the new line of Kennametal Adjustable Head Boring Bars. Call your Kennametal Representative, or write KENNAMETAL INC., Latrobe, Pa.

K-Bar cross section, showing steel core encased by Kennametal sleeve.

FOR THOSE EXTRA TOUGH OPERATIONS

. . . the new Kennametal adjustable head design is also available as a "K-Bar" . . . encased with a solid Kennametal sleeve to provide the rigidity necessary to stop vibration and chatter.

Almost as rigid as a bar of solid carbide, the K-Bar prevents taper, weaving and dragout scoring, reduces chipping and chatter damage to cutting tips. Eliminating these problems thus permits successful use of harder grades of carbide inserts. On many jobs, a K-Bar can remove as much metal in one pass as on two or more passes with a steel bar. 3180

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A-10-181-1—Drills—*Ace Drill Corp.* Latest Catalog covers the entire line of high-speed steel and carbide drills, reamers, drill banks and special drills. (Page 181)

A-10-223—Toolholders—*Adamas Carbide Corp.* Free copy of "Throwaway Tooling Set-up and Follow Thru" gives information on Dex-A-Tool. (Page 223)

A-10-64 — Steel Publications — *Allegheny Ludlum Steel Corp.* Complete list of A-L publications gives full data on more than 125 technical publications now available. (Page 64)

A-10-53—Screws—*Allen Mfg. Co.* New Allen Hex-Socket Screw Handbook has 112 pages of up-to-date technical information. (Page 53)

A-10-8 — Lathes — *The American Tool Works Co.* Bulletin No. 116 describes and illustrates the features of "American" DeLuxe Model Pacemaker. (Page 8)

A-10-146—Hack Saws—*Armstrong-Blum Mfg. Co.* New Marvel catalog gives complete story on Marvel metal cutting saws. (Page 146)

A-10-175—Carbide Tools—*The Atrax Co.* 96-page book "Standard Solid Carbide Tool Reference" available. (Page 175)

A-10-54—Special Machines—*Barnes Drill Co.* Bulletin 150G gives complete data on production flexibility of BarnesdriL special machines. (Page 54)

A-10-171—Optical Gage—*Bausch & Lomb Optical Co.* Catalog D-285 describes B&L DR-25 optical gage. (Page 171)

A-10-241-1—Chuck Jaws—*Bedford Gear & Machine Products, Inc.* New catalog and data sheets describe products of Bedford Gear. (Page 241)

A-10-35—Air Motors—*The Bellows Co.* Booklet available "Controlled Air Power" has cost-cutting ideas. (Pages 34-35)

A-10-14—Surface Grinders—*The Blanchard Machine Co.* Free booklet "The Art of Blanchard Surface Grinding" describes grinding wheels and their proper selection for surface grinders. (Page 14)

A-10-49—Speed Reducer—*Boston Gear Works Co.* Catalog OP-1 lists complete Optimount data including selection charts and application information. (Page 49)

A-10-191 — Cutting Tools — *Brown & Sharpe, Cutting Tool Division.* Nelco catalog shows over 700 standard carbide and carbide-tipped tools. (Page 191)

A-10-32—Surface Plate Equipment—*The Challenge Machinery Co.* Catalog describes the standard precision surface equipment. (Page 32)

A-10-151—Rivets—*Chicago Rivet & Machine Co.* Rivet catalog describes 1388 standard tubular and split rivets, 26 automatic rivet setters. (Page 151)

A-10-155—Carbide Cutting Tools—*Circular Tool Co., Inc.* Catalog O describes complete line of Circular metal cutting saws. (Page 155)

A-10-BC — Hydraulic Presses — *Clearing Machine Corp.* Catalog No. 231 and SB63 give examples of Clearing Hydraulics. (Page Back Cover)

A-10-184 — Optical Grinder — *Cleveland Grinding Machine Co.* Free brochure describes the capabilities of visual grinding machine for contour work. (Page 184)

A-10-185—Tool and Die Making—*Cleveland Tool & Die Co.* Free brochure describes the facilities of Cleveland Tool & Die. (Page 185)

A-10-207—Lapping Centers—*Crane Packing Co.* Latest bulletin describes Lapmaster lapping centers. (Page 207)

A-10-41—Projectors—*Eastman Kodak Co.* Illustrated booklet "Kodak Contour Projectors" gives details on production uses of projection equipment. (Page 41)

A-10-20—Index Table—*Erickson Tool Co.* Catalog K "Erickson Master Spacer" gives applications for Erickson holding tools. (Page 20)

A-10-233 — Indicators — *Federal Products Corp.* Brochure gives complete information on new Testmasters. (Page 233)

A-10-206-3—Lubricants—*Fiske Bros. Refining Co.* Bulletins describe Fiske Darl Base Oil and other specialty lubricants and coolants. (Page 206)

A-10-226 — Surface Broach — *Foote-Burt Co.* Circular No. 503 describes surface broaching of small parts. (Page 226)

A-10-248-2—Carbide End Mill—*The M. A. Ford Mfg. Co., Inc.* Catalog bulletin 601 lists specifications of Ford solid carbide end mills. (Page 248)

A-10-190—Toolmaker's Microscope—*The Gaertner Scientific Corp.* Bulletin 147-56 shows applications, models and specifications of various microscopes. (Page 190)

A-10-154—Air Valves—*Nopak Division, Galland-Henning Mfg. Co.* Complete Nopakmatic story on uses of valves for air control available in catalog 105. (Page 154)

A-10-204 — Air Drills — *Gardner-Denver Co.* Bulletin 92 gives complete information on airfeedrills. (Page 204)

A-10-27—Superfinishers—*Gisholt Machine Co.* Superfinisher catalog contains revised material from original textbook "Wear and Surface Finish," plus machine data. (Page 27)

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A-10-249—Machine Tools—*Greenlee Bros. & Co.* Catalog No. A-405 describes standard automatic bar machines. (Page 249)

A-10-192—Progressive Dies—*B. Jahn Mfg. Co.* Brochure about B. Jahn die designing and manufacturing facilities available. (Page 192)

A-10-50—Welding Machines—*Lincoln Electric Co.* Specifications and engineering data on shield-arc generator welders contained in Bulletin SB-1362. (Page 50)

A-10-21—Circular Saws—*Motch & Merryweather Cutting Tool Mfg. Div.* Pocket-sized guide to sawing operations available in new M&M Circular Sawing Handbook. (Page 21)

A-10-178—Thread Rolling Heads—*National Acme Co.* Cost-cutting ideas on Acme-Fette self-opening thread rolling heads for present equipment described in Bulletin NAF-57A. (Page 178)

A-10-159—Paint Stripper—*The Oakite Products, Inc.* Complete information on stripper S-A in new booklet. (Page 159)

A-10-68—Induction Hardening—*Ohio Crankshaft Co.* Free booklet describes "Typical Results of TOCCO Induction Hardening and Heat Treating." (Page 68)

A-10-28 — Grinding Machines — *Olivetti Corp. of America, Machine Tool Division.* 22-page illustrated catalog describes grinding machines with hydraulic automatic infeed. (Page 28)

A-10-174—Air Grinder—*Onsrud Machine Works, Inc., Portable Air Tool Division.* Air turbine grinder described in Bulletin 1126. (Page 174)

A-10-236-1 — Auto-Collimator — *Opto-Metric Tools, Inc.* Circular 85-200 describes Leitz Auto-Collimators. (Page 236)

A-10-143—Air and Hydraulic Cylinders—*Ortman-Miller Machine Co.* Two new catalogs—107 for air cylinders and 108 for hydraulic cylinders—now available. (Page 143)

A-10-209—Aluminum Tooling Plate—*Pioneer Aluminum, Inc.* Complete information on Pioneer 921-T direct chilled aluminum tooling plate. (Page 209)

A-10-55—Die Sets—*Producto Machine Co.* New catalog No. 11 makes ordering and selection of die sets easy. (Page 55)

A-10-177—End Mills—*Putnam Tool Co.* Information on end mills for aluminum shown in catalog 457. (Page 177)

A-10-217—Tap and Die Holders—*R and L Tools, Inc.* New catalog available on complete line of cutting tools and holders. (Page 217)

A-10-150—Punches and Dies—*Ring Punch & Die, Inc.* Illustrated catalog 105 contains information on standard Ring punches and dies. (Page 150)

A-10-186—Angular Tooling Equipment—*Omer E. Robbins Co.* Complete range and models of magnetic sine "Magnasine" inspection sine plates and heavy-duty sine plates shown in new catalog. (Page 186)

A-10-170—Clutches—*Rockford Clutch Div., Borg-Warner.* Bulletin shows typical installations and applications of Rockford clutches and power take-offs. (Page 170)

A-10-200-4—Bearings—*Southwest Products Co.* Revised engineering manual describes complete line of Monoball (self-aligning bearings). (Page 200)

A-10-142—Tumble Jigs—*Standard Parts Co.* Free bulletin describes details of new "Tumble" box jig. (Page 142)

A-10-10—Socket Screws—*Standard Pressed Steel Co.* Fastener reliability information in copy of new SPS booklet "High Reliability". (Page 10)

A-10-245—Dial Indicators—*L. S. Starrett Co.* Catalog describes complete line of Starrett high-precision low-friction dial indicators. (Page 245)

A-10-16—Die Sets—*Superior Steel Products Corp.* Great line of Superior die sets described in 24-page catalog. (Page 16)

A-10-201—Grinders—*The Thompson Grinder Co.* Catalog T558 gives information on Truforming grinders. (Page 201)

A-10-220-1—Balancing Machines—*Tinius Olsen Testing Machine Co.* New Rava electro-dynamic balancing machine described in Bulletin 56. (Page 220)

A-10-147 — Cylinders — *Tomkins-Johnson Co.* Bulletin SM115-3 gives engineering details on T-J cylinders. (Page 147)

A-10-208—Multiple Drill Heads—*U. S. Drill Head Co.* Standard sizes of adjustable heads described in Catalog AD-57. (Page 208)

A-10-220-3—Tube End-Forming — *The Vaill Eng. Co.* Tube end-forming machine described in Bulletin T-1. (Page 220)

A-10-140—Carbide Tools—*Vascoloy-Ramet Corp.* Catalog VR-58 gives complete details on carbide, ceramic and cast alloy cutting tools. (Page 140)

A-10-216-1—Cutting and Deburring Machine—*Wallace Supplies Mfg. Co.* Free 44-page booklet on Wallace cut-machining on cutting machines. (Page 216)

A-10-212-1—Adjustable Dies—*S. B. Whistler & Sons, Inc.* Catalogs describe magna-die, adjustable dies and facilities for custom die work. (Page 212)

A-10-181-2—Tube Forming Machinery—*The Yoder Co.* Illustrated 88-page book discusses the important aspects of cold-roll forming. (Page 181)

A-10-148—Multi-Spindle Adjustable Head—*Zagar, Inc.* Data sheets 93-E-10 give us engineering information and specifications on multiple spindle adjustment heads. (Page 148)

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Field Notes

Reflecting its optimism in the industrial future, Chrysler Corp. continues to drive toward progressive expansion. L. L. Colbert, Chrysler president, speaking at the automotive preview in Miami Beach, pointed out that by the end of the year his company will have invested about $85-million in plants and equipment. Since 1946, Chrysler's total investment in plants and equipment has amounted to about $1-billion—with another $½-billion for tooling.

Mr. Colbert's prediction of passenger car sales for the coming year is between 5½ and 6 million. Chrysler's expenditure for cars to meet this anticipated market was approximately $150-million. This appears concrete support to his statement that "We appear to be on our way out of recession."

expansions

An industrial expansion program involving $2-million has been initiated by Cleaver-Brooks Co. It will include a 70,000-sq ft addition to the firm's Lebanon, Pa. eastern manufacturing center and a new 25,000-sq ft production facility at Stratford, Ontario, Canada. The Lebanon expansion, which will more than double plant's production space, will cost about $1-million and is expected to be ready by December 1. The Stratford program, involving a capital outlay of about $900,000, is slated for occupancy late this year with initial production scheduled for early 1959.

V V V

Sahlin Engineering Co., Inc. has increased its Birmingham, Mich. plant area by 5,000 sq ft which will be used primarily for development of new products and special automation machinery.

new offices

A district sales office has been set up by Jessop Steel Co. in Houston, Texas to serve the Texas and Oklahoma area.

V V V

Technitrol Engineering Co. opened a West Coast office at 252 N. Irving Blvd., Los Angeles. The office will provide manufacturers of electronic equipment in that area with technical assistance on problems of complex design involving pulse transformers and delay lines and provide a source of information on the company's line of equipment.

V V V

Opening of a new and expanded Chicago office and warehouse at 3050 N. Cicero Ave. was announced by The Capewell Mfg. Co.

trade associations

Standards and tolerances for commercial forgings are under preparation by a committee of engineering and production executives of Drop Forging Assn. member companies. Committee chairman T. L. Swansen, vice-president of Ladish Co., stated that the standards must be designed to help the trained quality control people. Plan is to publish the latest technical information on modern forgings in complete form for convenient use by designers, metallurgists and engineers.

V V V

In the future, major national meetings of The American Society of Mechanical Engineers and the American Rocket Society will be held independently of each other. Decision for this major policy change grew out of the "increasingly independent status of the field of rocketry and the concurrent growth of ARS" as well as the expanding size of the technical sessions and limited hotel space available.

V V V

In an effort to help both members and nonmembers understand the functions and objectives of its association, The Material Handling Institute, Inc. has prepared a 16-page brochure. It answers 25 pertinent questions, presents plans, policies and procedures for serving member companies, and outlines aims and reasons for the institute's existence.

V V V

National Machine Tool Builders' Assn. is producing a movie, "One Hoe for Makwanga," designed to tell the story of machine tools to the general public. Purpose of the film is purely educational. It will show relationship between machine tools and standard of living, explain interchangeability of parts and quantity production, and show machine tools making working parts of products used for daily comfort and convenience as well as showing machines upon which we depend for industrial processes. It also will show how the nation does rely upon machine tools for national defense, and also explain that machine tools create jobs rather than destroy them. Copies of the movie are expected to be available early next year.

new activities

Entry into manufacture of electrical relays was announced by Robertshaw-Fulton Controls Co. The company's Acro Div. will handle manufacture and sales of the new line which comprises two relay developments considered suitable for a large percentage of all nonmilitary applications.

V V V

The Vee Bee Mfg. Co. has started production in Muskegon, Mich. on boring bars and cutters for metalworking applications.

new facilities

The Janitrol Aircraft Div. of Surface Combustion Corp. has started operations in its new $2½-million plant in Columbus, Ohio. Specialized components for the aircraft industry are manufactured at the new factory. An altitude chamber, one of the largest of its type in the country, has been installed for research and environmental testing of commercial products.

V V V

SPS Western, recently created West Coast wing of Standard Pressed Steel Co., has started production of steel shop and office equipment and aircraft fasteners. The new $5-million, 280,000-sq ft. plant, located in Santa Ana, Calif., will reach full operation with probably 500 persons, possibly by early 1959.

V V V

New plant facilities in Niagara Falls which will cost approximately $6-million have been authorized by The Carborundum Co. The plant will incorporate results of more than two years of engineering development. Although the plant will be fully automatic, it will feature important specially designed automatic and semiautomatic equipment.

V V V

Modern warehouse-service center to serve Detroit area industry has been established by Eutectic Welding Alloys Co. of Michigan, Inc. at 416 W. Eight Mile Rd in Detroit. Besides being the sole source in the state of Michigan

for Eutectic's Low Temperature welding alloys and Eutector fluxes, the Service Center also will be headquarters for a Eutectic Welding Institute, the Technical Information Service and other services to help local industries solve maintenance and production welding problems.

V V V

A plant in Fort Smith, Ark. has been acquired by Pendleton Tool Industries, Inc. for manufacture of Duplex tool boxes. New machinery and equipment is being installed in the 18,000-sq ft plant to enable Duplex Mfg. Corp., a Pendleton subsidiary, to increase production and improve designs of its product.

V V V

Illinois Tool Works has established a West Coast division to be known as the Calinoy Div. The office and plant facilities, located at 12917 Cerise Ave., Hawthorne, Calif., will function as the West Coast headquarters for sales, engineering and manufacturing of fasteners designed and developed for special purpose applications in the missile and aviation industries. It also will function as the district sales office for distribution of products of the Shakeproof and Fastex Divs.

V V V

A manufacturing and repair plant will be built by Westinghouse Electric Corp. in Baldwin, Fla., 20 miles west of Jacksonville. The facility, located on a 4.5 acres site, will house about 18,000 sq ft of shop and office space.

competition

"Materials Handling — Tomorrow's Solutions of Today's Problems" is the theme for the 1959 Clark Essay Contest. First prize in the competition is $2000 while nine other prizes totaling $3000 also will be awarded. Closing date for the contest, sponsored by the Industrial Truck Div. of Clark Equipment Co. and conducted by the American Materials Handling Society, April 3, 1959. Papers will be judged on analysis of subject, value in its field, originality, organization of material and use of visual aids.

new companies

Formation of Allied Control Co. of Canada, Ltd. was announced by its president, E. H. Gillette. Initial purpose of the new company, located at 1500 St. Catherine St. W., Montreal, is to facilitate supply of Allied Control and Siemens & Halske relays and other components.

V V V

Lerma Engineering Corp. has established headquarters in Northampton, Mass. The new firm will design and manufacture remote viewing instruments, special periscopes and borescopes, optical tooling, inspection devices, optical systems and precision optics. President of the company is John L. Maulbetsch, former vice-president and general manager of Kollmorgen Optical Corp. while vice-president is John J. Lerse who was chief development engineer in charge of industrial periscopes at Kollmorgen.

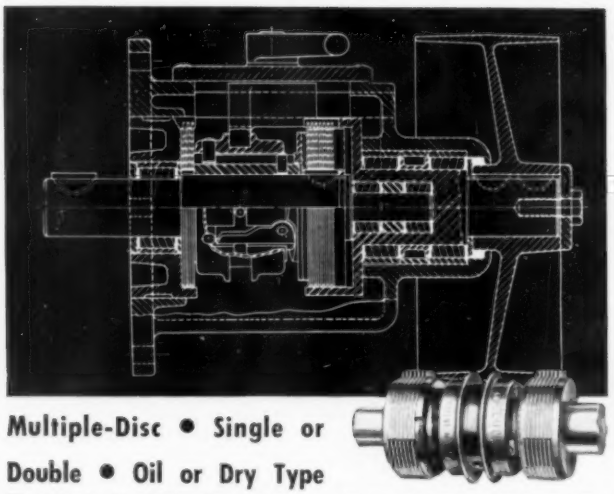
V V V

George Harmon and Associates has been organized as a manufacturers design service. Offices for the firm are in the Kirk Bldg., 220 S. Williams St., South Bend, Ind.

V V V

Axleson Fishing Tackle Mfg. Co Inc. recently was formed in Santa Ana, Calif. J. C. Axleson, formerly board chairman and general manager of Ax-

ROCKFORD



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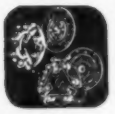

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Heavy Duty Over Center

Power Take-Offs

Speed Reducers

CLUTCHES

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leson Mfg. Co., is president of the new firm. James Gourley, a member of ASTE's Santa Ana Valley chapter, is vice-president.

V V V

G. T. Lyon, president of L & L Mfg. Co. has formed a new corporation which purchased Birmingham Hydraulic products Co. and changed the name to Birmingham Hydraulic, Inc. The firm will continue to manufacture hydraulic panels, drilled manifolds, side entering subplates and Pan-Sec panel sections at its plant at 8088 E. Nine Mile Rd., Van Dyke, Mich.

agreements

Gisholt Machine Co. recently acquired United States distribution rights to the Cri-Dan line of high-speed semiautomatic single point threading machines.

V V V

Homestrand, Inc. now is exclusive U.S. agent for the Swedish S.P.V. tapping attachments and has taken over sales and services of the line, including stocking of spare parts.

V V V

Wales-Strippit, Inc. has licensed Les Ateliers H. Raskin S.A. of Liege, Belgium, to manufacture and sell all the firm's products in continental Europe. Raskin Press operates two plants in Liege.

V V V

All national and export sales and distribution of Diebel Hi-Production automatic presses now are handled by Sales Service Machine Tool Co. The line recently was purchased and combined with Press-Rite O.B.I. presses and production moved from Chicago to the Press-Rite plant in St. Paul.

acquisitions

First step in National Tool Co.'s long range diversification program has been accomplished with acquisition of the Auto-Vac Co. of Bridgeport, Conn. E. Bowman Stratton, Jr., former president of Auto-Vac, became a vice-president of National Tool in charge of the new Auto-Vac Div.

V V V

Baker Brothers, Inc. has bought the Detroit Screwmatic 750 line from Gear Grinding Machine Co. Name of the machine will be changed to Baker automatic bar machine.

V V V

Entire Reicherter Elasticometer spring tester inventory, valued at more

New! BAUSCH & LOMB DR-25 OPTICAL GAGE

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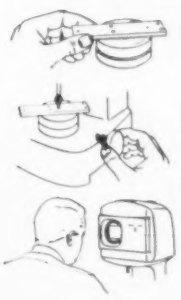

A Just set part to be measured on anvil . . . no masters or set gages needed. Large work table makes it easy to adapt special fixtures, accommodates widest variety of work.

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than $100,000, was purchased from the Testing Equipment Co. by The Carlson Co. which also signed a five-year agreement to be the sole representative in the United States and Canada for these spring testers. Carlson also acquired the right to use the name Testing Equipment Co. although the firm will continue to use its present name.

V V V

A new division of Wheelabrator Corp. was formed as a result of acquiring Crandall Engineering and Manufacturing, Inc. which will now be known as the Techline Div. The new division, with headquarters at Vicksburg, Mich. will be responsible for manufacture and sale of precision finishing equipment. Experimental and demonstration laboratories also will be maintained in Vicksburg.

name changes

The manufacturing firm which has been known as Uniseal Co. now will be officially identified as Aero-Stat Co. of California. It will continue to produce self-sealing fasteners and will soon begin manufacture of access doors for aircraft and related industries.

V V V

Computer Equipment Corp. is the new name adopted by Digitron, Inc. in order to clarify the nature of the business in which the firm is engaged.

V V V

The Bryant Gage and Spindle Div. of Bryant Chucking Grinder Co. has been reorganized and renamed Bryant Computer Products Div. Personnel and manufacturing facilities have been increased to meet the increased market for this division's products.

moves

Navan Products, Inc. subsidiary of North American Aviation, is moving its general offices from Santa Monica, Calif. to 900 N. Sepulveda Blvd. at Imperial, International Airport, Los Angeles. The move to large offices is part of the company's sales expansion program.

V V V

Industrial Filtration Div. of U. S. Hoffman Machinery Corp. has been transferred to Syracuse, N.Y. where it is designated Thompson Road Plant No. 1.

V V V

Jones & Laughlin Steel Corp. has moved its Los Angeles district sales office to 2131 S. Garfield Ave. The Company's Stainless and Strip Div. also is located at that address.

Trade Literature

for free booklets and catalogs—use request card, page 167

Metal Ceramics

Physical, mechanical and chemical properties and typical applications of cermets covered in 12-page booklet; includes information on Haynes metal-ceramics LT-1, LT-1B and LT-2; illustrated. Haynes Stellite Co., Div. of Union Carbide Corp., Kokomo, Ind. **L-10-1**

Roller Chains, Sprockets

Comprehensive 154-page manual, Book 2657, contains detailed engineering data illustrating variety of applications for roller chain; includes textbook information on use of roller chain for power transmission and conveyor service, describes typical installation conditions; and includes formulas, charts and diagrams to simplify selection of proper chains for any application; also describes selection, application, installation, lubrication and maintenance of roller chains and sprockets for drives and conveyors. Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill. **L-10-2**

Fasteners

Illustrated 16-page pocket-size booklet, "Helpful Hints on Applying Standard Fasteners," contains technical facts to help users obtain maximum economy and performance in application of standard fasteners; also includes section on tapping screws with charts showing safe load curves and torque curves for various diameters and grades of bolts. Russell, Burdsall & Ward Bolt and Nut Co., 101 Midland Ave., Port Chester, N. Y. **L-10-3**

Forging

Twenty pages of forging data and information in Catalog F-1 on "Custom Forgings" covers all phases of subject from proper die design through forging methods, trimming, cleaning and inspection; includes technical section with detailed illustrations and tables on such items as quantity tolerances, web thickness, corner radii tolerances, machining allowance and mismatch tolerances. Request on company letterhead direct from Merrill Brothers, Caspian St., Maspeth, N. Y.

Transmission Belting

Graphs and tables serve to illustrate text in 4-page folder describing Coriamid adhesion transmission belting; includes complete specifications and information to aid in proper selection and use. Coriamid, Inc., 41 Commercial St., Fitchburg, Mass. **L-10-4**

Press Brakes

Catalog No. 2024A describes line of Steelweld hydraulic press brakes emphasizing various design and construction features; includes details of operations and specifications; illustrated. The Celeveland Crane & Engineering Co., Wickliffe, Ohio. **L-10-5**

NEW!
Eclipse
PORT CONTOUR CUTTERS
A.N.D. 10050
Eclipse
PORT CONTOUR CUTTERS
WITH
PRECISION GROUND FORMED RELIEF
INSURE
• LONGER LIFE • FINER FINISHES
and • ARE EASILY RESHARPENED
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Other types of form ground port contour cutters are made by Eclipse in both H.S.S. and T.C.T. for special machining operations.
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Drafting Standards

Illustrated 8-page report by William J. Gallagher and Carl E. Nelson of Bell Telephone Laboratories, on "Drafting Standards for Microfilmed Engineering Drawings" discusses simplified drafting, minimum letter heights, line and background densities for active engineering drawings to be microfilmed unitized and reproduced by electrostatic printing and offset. Filmsort Co., Div. of Miehle-Goss-Dexter, Inc., Pearl River, N. Y. **L-10-6**

Expansion Joints

Engineering data required to select, order and install S-R expansion joints included in 80-page catalog presenting complete information for rating joints subjected to axial or lateral movement, angular rotation or combination of these movements; gives formulae and tables for calculating forces and/or bending movements developed in connected piping or equipment. Badger Mfg. Co., 230 Bent St., Cambridge, Mass. **L-10-7**

D1-S Grinder on radial drill grinding hard spot on bearing seat.

here's the way to cut costs in hole grinding

...even when needed only a few times per year!

With the Onsrud D1-S Hole Grinder you can do precision grinding in your own shop. Designed for mounting on lathe, milling machine, jig borer or drill. Air turbine motor drive gives ¼ HP, 50,000 RPM grinding speed. A precision built unit throughout with vernier scale for adjustment to 0.0001". For grinding holes up to 2¾" diameter . . . or up to 4" with adapter plate. With the D1-S you can do precision hole grinding in your own shop . . . and control quality to your own standards at considerably lower cost. Experience shows it pays for itself, even when used only a few times a year. For complete information write for Bulletin 1725.

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HOLE GRINDER

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Milling Cutters

Extensively illustrated 48-page Bulletin No. 571 describes standard and special high-speed steel or carbide tipped milling cutters, as well as broaches, grooving tools, spar mills, chamfering tools, boring tools, reamers, slotting saws, rotary slitting knives, spacers and a variety of special purpose tools. Cowles Tool Co., 2086 W. 110th St., Cleveland 2, Ohio. **L-10-8**

Heat Treatment

Informative 8-page Datalog on Heat Treatments in Atmosphere Furnaces covers protective atmosphere furnaces for annealing, brazing and hardening of a variety of metals; also offers technical information on protective atmospheres such as dissociated ammonia, hydrogen, exorthermic, argon or helium in continuous, batch or pit type furnaces, and discusses materials that can be heat treated and types of parts and assemblies applicable to such heat treatments. Ferrotherm Co., 1861 E. 65th St., Cleveland 3, Ohio. **L-10-9**

Air Tools, Accessories

Spiral-bound 68-page Catalog L-8 shows line of air tools as well as custom built assembly equipment giving descriptions of uses and listing specifications; includes 5-page section on maintenance suggestions and tips for economical usage; indexed for easy reference. Cleco Div., Reed Roller Bit Co., 5125 Clinton Dr., Houston, Texas. **L-10-10**

Rubberized Abrasives

Eight-page catalog of rubberized abrasives for deburring, smoothing and polishing explains advantages of use of rubberized abrasive wheels, points, blocks, sticks and cones; contains operating instructions, application information, tables, illustrations and up-to-date technical data. Cratex Mfg. Co., 1600 Rollins Rd., Burlingame, Calif. **L-10-11**

Multislide

Versatility, operational simplicity and ease of tooling stressed in 8-page brochure describing Verti-Slide equipment for handling both wire and strip; well illustrated to show details of construction and operation. The Torrington Mfg. Co., Torrington, Conn. **L-10-12**

Honing

Four honing machines, honing heads adaptable to drill presses, mandrel driver and mandrels and abrasive stones are described in 30-page catalog illustrated by photos and drawings to explain important points; includes specifications. Superior Hone Corp., 1612 Elreno St., Elkhart, Ind. **L-10-13**

Barrel Finishing

Four-page "Glossary of Terminology" as approved by the National Barrel Finishing Forum defines language used in this field. BMT Mfg. Corp., 110-112 E. Ninth St., Elmira Heights, N. Y. **L-10-14**

Carbide Tools

Illustrated 44-page Catalog No. T-58 presents line of tungsten carbide tools; gives specification tables and tolerances for each style in line and outlines important design features and uses. S & E Machine Products Inc., Bridgeport, Mich.

Fluid Power Circuits

Revised 28-page edition of "Circuit Rider" meets new requirements in the fluid power field; air and hydraulic circuits shown have been field tested; circuits cover sequencing, semiautomatic cycling, dual pressure systems, safety systems, skip feed arrangements and synchronization of two cylinders. All circuits are completely explained. Logansport Machine Co., Inc. Logansport, Ind. **L-10-15**

Electric Clutches

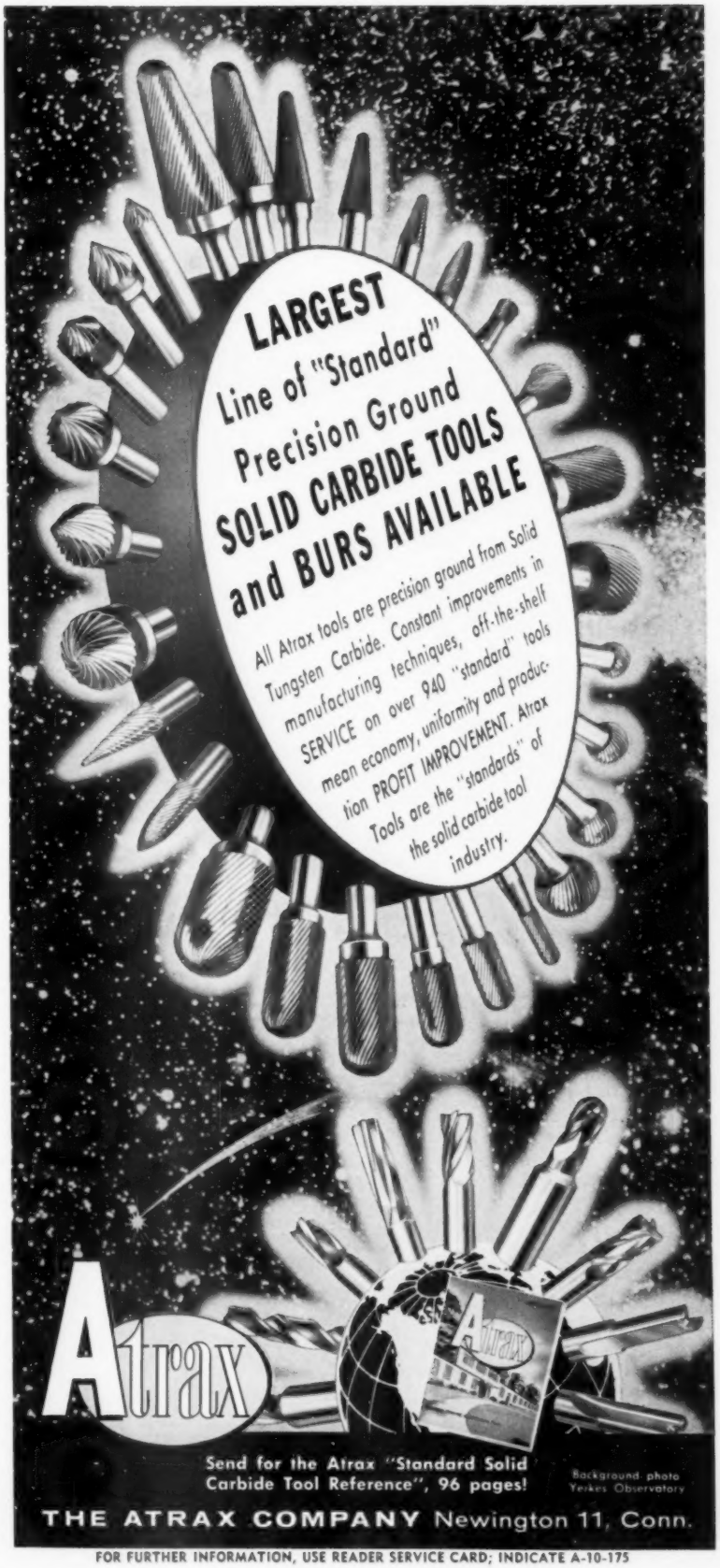
Electrically operated I-T-E Electro clutches described in 20-page Catalog 6304-1A which provides detailed application reference material for their use by machine tool and machinery designers and application engineers; gives examples of applications, and includes data and specifications on complete clutch line and summarizes general application information; also describes accessories and accessory parts. Transformer and Rectifier Div., I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa. **L-10-16**

Metal Specifications

Sixteen-page booklet, "Metal Specifications and Practices in the United States," summarizes lecture material presented by Roger F. Waindle, president of WaiMet Alloys Co., before European Investment Casters Assn.; text, graphs, photo-micrographs and electron micrographs describe development and standardization of casting alloys used in U.S. WaiMet Alloys Co., 1999 Guoin St., Detroit 7, Mich. **L-10-17**

Switches

Comprehensive 32-page brochure offers information on precision electrical switches; pictures each type with dimensional diagrams and specifications; includes dictionary of terms and brief technical discussion of switch operations. Licon Switch & Control Div., Illinois Tool Works, 2501 N. Keeler Ave., Chicago 39, Ill. **L-10-18**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LAPPING MACHINES

- precision flatness
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- in production quantities

Save time in the lab, speed production in the plant

In the laboratory or in the plant, a single SYNTRON Vibratory Lapping Machine — or a battery of them — provides a fatigue-reducing, time-saving means of lapping and/or polishing metal surfaces for metallographic examination or for mating purposes.

In the lab, the technician is freed for more important tasks while the Lapping Machines do the hard work.

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Our lapping department is also equipped to lap and/or polish parts in quantity on a contract basis should your production require too few parts to warrant the purchase of a SYNTRON Lapping Machine.

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Lapping Machines	Paper Joggers

Our representatives will be glad to work with you in selecting the proper equipment for your operation.

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For more information write for complete catalog . . *Free*

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Metal Castings

Thirty-page "Metal Castings Answer Book" points out in question-and-answer form the advantages and uses of malleable iron, pearlitic malleable iron, gray iron, aluminum and magnesium and numerous typical applications; includes descriptions and pictures of casting operations. Dayton Malleable Iron Co., Dept. P, P. O. Box 980, Dayton 1, Ohio. **L-10-19**

Polishing and Buffing

Illustrated 16-page catalog describes straight line type automatic polishing and buffing machine covering basic factors to consider in selection; information includes design features, operating descriptions and typical applications, for reciprocating, fixture-return, horizontal-return, over-and-under, rectangular, universal and rotary-conveyor models. Acme Mfg. Co., 1400 E. Nine Mile Rd., Detroit 20, Mich. **L-10-20**

Diamond Tools

Compiled as a guide to tool selection for specific jobs, 14-page catalog on "Diamond Tools for Industry" outlines suggestions on care and use of diamond tools and shows sketches and specifications for of tools for dressing, grinding and machining. New York Diamond Tool Co., Inc., 360 Glenwood Ave., East Orange, N. J. **L-10-21**

Automation

Eight-page Bulletin GED-3684 discusses numerically-controlled machines to provide flexible automation to permit economic production of job lot orders and prototype development; suggests steps toward establishing this type automation and gives checklist for establishing usefulness of such equipment; illustrates points with case histories. General Electric Co., Schenectady 5, N. Y. **L-10-22**

Belt Conveyors

Illustrated with graphs and charts, 8-page "Engineering Guide" provides information to enable the engineer to design and specify his own steel belt conveyor; includes information on properties of both carbon and stainless steel belts, methods of support, end joints, inclines, belt tension and other pertinent data. Sandvik Steel, Inc., Fair Lawn, N. J. **L-10-23**

Plastic Metals

Complete discussions of chemical and physical properties of Plastic Steels and Aluminum Putties created for metalworking, plastics and other industries covered in 12-page Catalog NI-103; includes illustrated case history type application data. Devcon Corp., Danvers, Mass. **L-10-24**

technical shorts

'Elastic' Plastic Quiets Vibration

HARDNESS, strength, rigidity, resilience, elasticity, load carrying, abrasion resistance, oil resistance and oxygen or ozone resistance are reportedly all combined in a new plastic material called Vulkollan. According to Kenneth A. Pigott of the Mobay Chemical Co., it will snap back to its original size after being stretched to five or six times its original length.

Its peculiar combination of qualities makes the plastic useful for applications such as handles for air hammers where it maintains rigidity while tending to minimize vibration.

The material already has been used in Germany to make motorcycle sprocket gears. According to report, the gear itself is thin and flexible, but the gear teeth are rigid enough to drive the motorcycle. Such gears, engineers claim, have lasted for more than 60,000 miles of operation with no appreciable sign of wear.

* * * * *

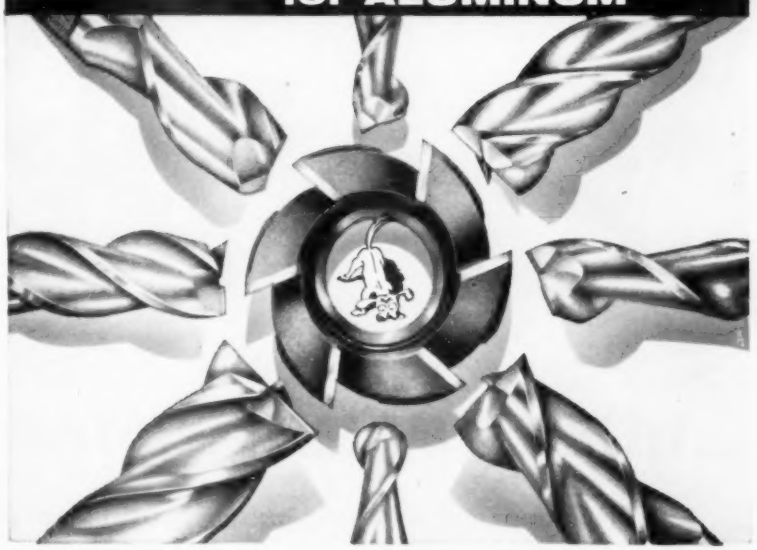
Radiant Lamps Imply Changes For Heat Treat

DEVELOPMENTS in industrial heating may give a new look to some types of processing in this field. A system under study by Research Inc. employs high intensity radiant heat lamps which literally "shine" heat energy into the object being heated. James Anderson, project engineer, reports that transmission rates up to 100 per square foot have been achieved. Heating can take place wherever sufficient power can be applied—no enclosure is needed, thus work need not be moved or confined. Design permits choice of manual, set point or remote operation modes; safety interlocks protect the equipment and the operating personnel. Because of air cooling, there is no need for water connection.

During the process, a single channel Ignitron Controller regulates heat lamp output according to temperature of the heated specimen. In some cases multiple channel controllers are used in banks of three. By adjusting two knobs, the operator can select the rate at which initial heating occurs and the desired set-point temperature. Precise and automatic temperature control is easy to attain because the controller operates to produce almost instantaneous changes in heat input rate. Also, with the controller there is no warm-up period.

Initial applications of the equipment have been in testing aircraft structures and in bonding laminated materials. However, possibilities are indicated in curing of plastic or ceramic coatings, heat treatment of metals or in production brazing, welding, soldering and forming processes. Still another advantage may be its possible value as a voltage or current regulator in the 0-100 kva range.

First COMPLETE LINE OF STANDARD END MILLS for ALUMINUM



Again PUTNAM LEADS . . .

For further information on Putnam End Mills for Aluminum, write for Catalog 457.

Standard End Mills . . . For the first time you can select from a complete line of **standard** end mills designed specifically for milling aluminum . . . Putnam stocks 185 **standard** types and sizes.

New Designs . . . These **standard** end mills have been developed through years of research and experience on aluminum applications. Over two years ago, Putnam introduced the first **standard** end mills designed for milling of aluminum. Today, no other manufacturer offers as complete a line of **standard** end mills for aluminum.

Contact your Putnam Distributor for personalized service, quick delivery of the finest standard end mills for aluminum.

PUTNAM TOOL COMPANY
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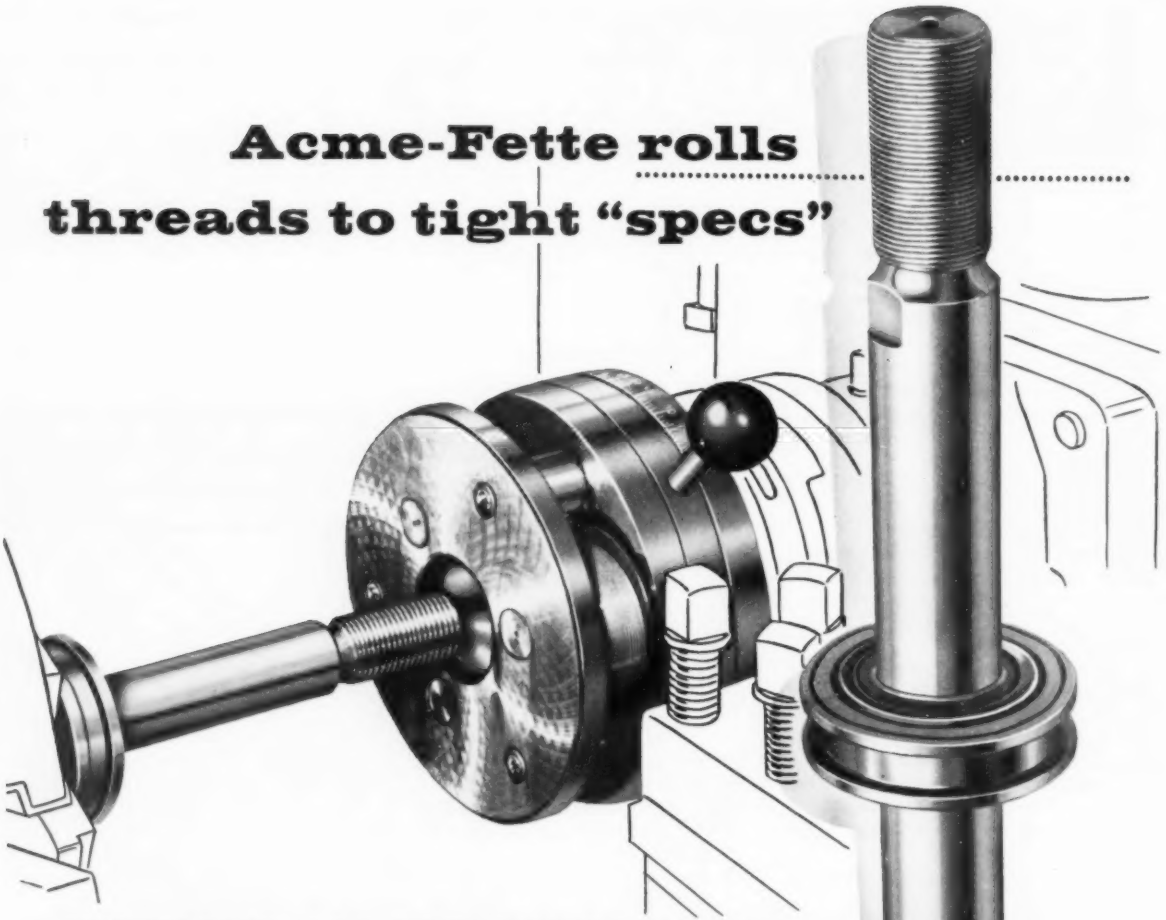
Acme-Fette rolls threads to tight "specs"



...WITHOUT MAJOR INVESTMENT

The tool engineers of Air-Hydraulic, Inc. were faced with rigid specifications and the necessity of an extremely fine fit and finish for this high temperature hydraulic actuator for aircraft use. Conventional thread cutting methods would have been costly.

After careful study they found that Acme-Fette thread rolling heads would meet all requirements when applied to their *existing turning equipment.* Major machine investment was eliminated and a low rejection rate meant additional economies because threading was the last of a number of costly operations.

The Results

- 1"-20, ¾"-16, and 5/16"-24 threads were rolled 5 times faster than possible with conventional thread cutting dies —thread rolling speeds are equal to turning speeds with high speed tool steels.
- Cold-forming action of the Acme-Fette produced a tougher thread and one 60% smoother than grinding or chasing (a 5 micro-inch finish).
- Rejection rate: less than ¼ of 1%.

For cost-reducing ideas showing how you can put Acme-Fette self-opening thread rolling heads to work on your present equipment, send for Bulletin NAF-57A.

The Material

- Steel: 4340—upset forging
- Tensile strength: over 160,000 p.s.i.
- Hardness: 36-40 on Rockwell C scale

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Men at Work

Edward G. Maylinger (left) and Kenneth W. Meytrott (right) were elected president and board chairman, respectively, of Ettco Tool & Machine Co., Inc. following the recent death of Melvin H. Emrick. Both men formerly were vice presidents of the firm while Mr. Maylinger also was treasurer.

E. N. SMITH was appointed technical director of Kennametal Inc. chemical and metallurgical laboratory in Latrobe, Pa. This facility serves as a testing and quality control center for several plants in the Latrobe area. For the past five years he has been metallurgical superintendent in charge of refining, powder preparation and sintering operation.

HARVEY D. CHICOINE was named plant manager for the Cleveland Works, and C. A. Fike became assistant to the division manager of Westinghouse Electric Corp.'s lighting division recently. Mr. Chicoine, a member of ASTE's Akron chapter, was previously assistant manager of manufacturing for the division; Mr. Fike who has been with Westinghouse for 46 years, has been manager of manufacturing.

DUANE R. BRANAKA recently was made sales manager of Valvair Corp. to supervise sales of the company's manual and pilot-operated control valves.

Technitrol Engineering Co. recently made ROY HOCK chief engineer, responsible for technical direction of all engineering projects. He has been a senior supervisory engineer.

Promotion of ROBERT B. NOREN to sales manager of the Special Products Div. was announced by The Chicago Screw Co., a division of Standard Screw Co. Mr. Noren formerly was in charge of special products sales for one of Chicago Screw's two territories.

At the same time, H. T. THOMPSON was promoted to sales manager, standard fastener products for the Chicago Div.

Appointment of WALTER WELKOWITZ as director of engineering for the Vibro-Ceramics Div. was announced by Gulton Industries, Inc. Dr. Welkowitz will direct all engineering and research activities in the fields of industrial ultrasonics and medical-electronic instrumentation.

Three executive promotions at Koehler Aircraft Products Co. involved DONALD J. MACFADGEN, who became vice-president, engineering; HAROLD A. HERKENHINE, now chief engineer; and GEORGE FOSTER, vice-president, West Coast operations. Mr. MacFadgen has been chief engineer since December 1955, while Mr. Herkenhine was formerly assistant chief engineer, and Mr. Foster has been West Coast design engineer.

MARLIN KIRK is the new sales manager of Potter & Brumfield Canada Ltd. a new Potter & Brumfield subsidiary which will manufacture electrical relays for the Canadian market. For the past seven years, Mr. Kirk has been associated with P&B in various sales and production control capacities.

Administrative changes in management of the Ball and Bearing Div. of the Hoover Ball and Bearing Co. included election of WILLIAM C. LIGHTHALL as a vice-president of Uniloy, Inc. a wholly owned subsidiary. Mr. Lighthall, who joined Hoover in 1949, has been factory manager since 1952.

At the same time, the company appointed ROBERT C. RESSLER, vice president, to the position of general manager of the Ball and Bearing Div.; and made JAMES C. CARMAN assistant general manager of the division. Mr. Ressler is a member of ASTE's Ann Arbor chapter.

CLARENCE A. PRICE is new president of Uniloy, Inc., a wholly owned subsidiary of Hoover Ball & Bearing Co. Mr. Price formerly was vice president of Uniloy and general manager of its Unit Products Div.

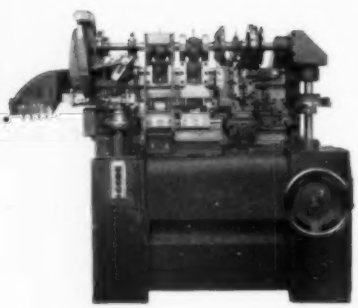
Following organizational changes in units that constitute the Industrial Products Group of Minneapolis-Honeywell Regulator Co., GEORGE M. MUSCHAMP became group vice-president-engineering, and O. B. WILSON was made group vice-president-marketing. JOHN M. WILSON, head of design and development, was named director of engineering, relieving Mr. Muschamp of direct responsibility for Brown's engineering department. Mr. Wilson formerly was Brown sales vice-president.

At the Porcelain Enamel Institute, WILLIAM E. PIERCE has been named to fill a newly created position of manager of product engineering. The post was created as part of an expanded product development and new applications program launched last year.

John F. Maher (left) former president of Oil Center Tool Co., was elected a director and new president of Reed Roller Bit Co. succeeding Rex G. Hamaker, who retired.

Ray O. Shaffer (right), president of Welex, Inc., was elected a director of Reed and will serve as chairman of the board.

THE FIRST ENTIRELY NEW FOUR-SLIDE IN FIFTY YEARS!



A development of industry-wide importance is the Torrington Verti-Slide—a new vertical 4-slide that is the first major innovation in the basic field of wire and strip forming equipment in half a century!

The Verti-Slide was designed to meet a serious need for greater versatility, lower tooling cost, faster set-up time and reduced floor space. We urge you to investigate the new Torrington Verti-Slide in detail.

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NORMAN A. FLETCHER is now manager of manufacturing for the Valve Div. of Minneapolis-Honeywell Regulator Co. He will supervise all factory operations including production control and purchasing.

BURTON J. NADEN was named to fill the newly created post of general sales manager of Vascoloy-Ramet Corp. He formerly was assistant manager of the General Production Dept.

JAMES C. DARBY is new general sales manager for the Truarc Retaining Rings Div. of Waldes Kohinoor, Inc. He formerly was Eastern sales manager for the Aircraft Div. of the Townsend Co., Inc.

Formerly chief engineer of The Barden Corp., BRUCE L. MIMS now is vice-president-engineering of the company.

Eclipse Counterbore Co. has announced appointment of J. TOM MAIDENS as sales supervisor for the End Mill Div. He formerly was district manager for Morse Twist Drill Co.

GLENN F. WHITELEY is new manager of the Indianapolis plant of Heppenstall Co. He has been the plant's chief metallurgist.

Promotion of JOSEPH J. BARRETT from assistant superintendent to superintendent of hot mills was made public by Carpenter Steel of New England, Inc. Mr. Barrett has been associated with the company since 1950.

Landis Tool Co. has advanced WALTER P. LOTZ from general sales manager to the office of vice-president in charge of sales. At the same time, JOHN A. COVER was promoted from manager distributor sales to sales manager, and JOHN J. KEAN, former assistant sales manager, became manager direct sales.

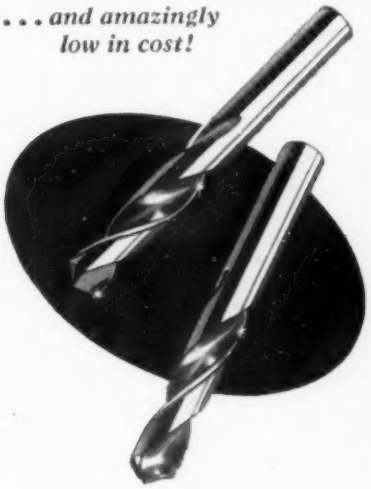
Grant Gear Works, Inc. named FORREST EMERY as sales manager for the company's line of gears, speed reduction units and other power transmission equipment. He will direct sales throughout the United States and Canada.

EDWARD A. TOOMEY, assistant general service manager of Yale Materials Handling Div., The Yale & Towne Mfg. Co., is now manager of the company's Forrest City, Ark., manufacturing plant.

HOWARD R. HOSKIN was named sales manager of the S. W. Card Div. of Union Twist Drill Co. Mr. Hoskin, who is a member of ASTE's Lorain County chapter, has been a sales engineer in eastern Ohio and western Pennsylvania for the past three years.

They're tough, they're versatile

. . . and amazingly low in cost!



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Call your local Ace Drill Distributor today!

NEW CATALOG covers the entire line of Ace "Ground-from-the-Solid" High Speed Steel and Carbide Drills, Reamers, Drill Blanks and Special Drills. Send for it today!

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ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

INDICATE A-10-181-1

TOOL ENGINEERING in Europe

By H. Kronenberg
Consulting Engineer
Cincinnati 6, Ohio

Rolling Mill Automation

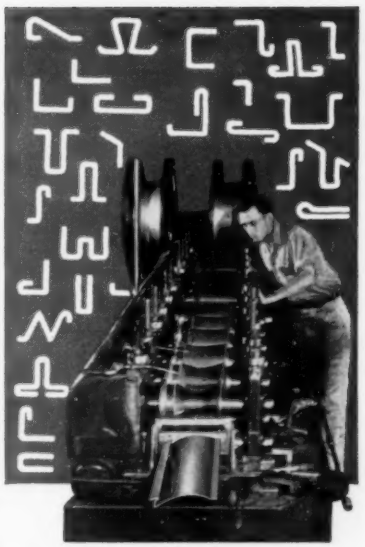
Automation has been used in rolling mills for many years on operations such as reeling, coiling and shearing. However, automation for the completion of a product as found on machining operations has not been applied to rolling mills until recently. The discussion of such mills may be found in an article by H. Vogl in *Stahl und Eisen*, Vol. 78, No. 5, under the title "Entwicklungs-Linie der Automatisierung in Huettenwerk."

Automation requires a balance of sequence of different operations as a prerequisite. In addition, automation has been considered most useful and economical where a number of the same end products are produced from a uniform preliminary product. These ideal conditions are rarely found in rolling mills. Hence, for the techniques of automation to apply, the process must be flexible. As an example, when a particular program has been completed, it may be necessary to have adjustable speed controls on the individual drives of the rolling stands for flexibility when changing to a different type of rolled product on the next program.

The author also discusses the control techniques associated with automation in the mills. He presents examples of rules, programming, counting, measuring and computing machine uses for control of both reversing and flow mills.

Hannover Industries Fair

This show, held yearly at Hannover in West Germany should not be confused with the European Machine Tool Show, which took place last year in the same city. The Industries Fair has visitors from all over the world, according to an article in *Overseas Post* No. 29, 1958. The show included exhibits of 4300 organizations from 22 countries.



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A great many modifications of the basic shape such as welding, coiling, ring forming, notching, perforating, embossing and cutting to length, can be simultaneously introduced with little or no additional labor cost. It will pay you big dividends to fully investigate the advantages of Yoder cold-roll forming. A fully-illustrated, 88-page book clearly discusses every important aspect of this amazingly versatile method of metal fabrication... it is yours for the asking.

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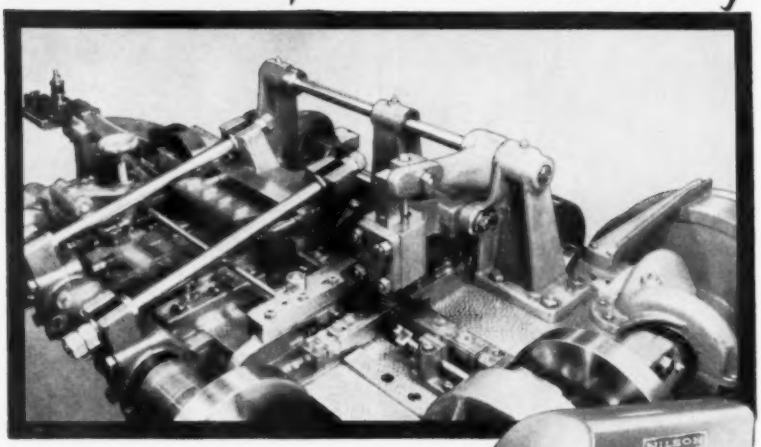

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Every Nilson 4-Slide Forming Machine is designed with built-in flexibility! Most models handle either wire or ribbon metal with equal speed and accuracy . . . can combine stamping, welding and other secondary operations with the basic forming cycle. Easy access to tooling insures rapid setups, minimum down-time for job changeovers.

Whatever your forming application, there's a Nilson 4-Slide to do the work faster, more economically! With 17 horizontal models and the new "Vertiform" machine, Nilson offers you the widest selection of 4-slide equipment.

Investigate the cost-cutting advantages of Nilson 4-Slides in your operations! For a production evaluation of your parts, send prints or samples today.

Illustrated at top is Model S-1-F Machine, showing built-in press and open construction of forming area. Directly above is the new Vertiform Machine.

SIZE RANGES:
Wire up to ½" diameter
Ribbon stock to 3½" wide,
Feeds up to 32"
5 TO 75 TON
PRESS SECTIONS

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AUTOMATIC WIRE & RIBBON METAL FORMING 4-SLIDE MACHINES • WIRE & STOCK REELS • WIRE STRAIGHTENING EQUIPMENT • AUTOMATIC STAPLE FORMING MACHINES • SPECIAL WIRE FORMING EQUIPMENT
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The German Secretary of Commerce, in opening the show, discussed the rapid recovery of West Germany. He acknowledged the fact that his country "recovered breath thanks to American support."

In the same issue, an article, written by W. Simonis, described the progressive design changes on milling machines. The author indicates that the vibration problems associated with milling operations have prompted milling machine manufacturers to introduce many new design features. These designs were developed to obtain vibration-free performance over the entire range of speeds and feeds. Ten pages of the latest products of 25 milling machine builders in West Germany and Switzerland are described.

Solubility of Tungsten-Carbide

An article, more on the scientific side of tool engineering, was written by J. Hinnüber and W. Kinna and published in *Archir fuer Eisenhü Henwesen*, Vol. 29, 1958, under the auspices of the committee for powder metallurgy. The title is "Ueber die Loeslichkeit von Wolfmankarbid in Titankarbid" and deals with the solubility of tungsten-carbide in titanium-carbide.

Discrepancies in literature covering the solubility of WC in TiC have been found. Since solubility may affect the tool life and wear resistance of carbide tools, the authors investigated the lattice constants of titanium-carbide and of titanium-tungsten-carbide crystals, using an electron microscope. A reliable balance was reached at a temperature of 2000 C (3632 F). Oversaturated crystals do not return completely to their initial stage upon cooling. The balance is facilitated by the presence of cobalt and by mechanical crushing. Cobalt content should be limited to a few percent, because phase shifting occurs with greater amounts.

Addition of 2-5 percent of tantalum carbide (TaC), as conventionally done in the manufacturing of carbide tools, reduces the solubility of WC in TiC; thus, TaC promotes the balance. Inhomogeneity often observed in the microstructure of the Tic-WC and TiC-WC-TaC crystals is caused by the composition. This condition depends upon the formation of the "cores" either by decomposition of an oversaturated crystal or by heating of a carbide mixture.

Profile Truing of Grinding Wheels

Experiments were conducted by H. Frank, who investigated the different surfaces produced by diamond truing heads fitted in different positions in relation to the grinding wheel. A report on these tests was published in *Industrie Anzeiger*, Vol. 80, No. 46, under the title "Untersuchungen ueber das Pro-

filabrichten von Schleifacheiben mit Formdiamanten." A cyclindrical grinding machine with a copy truing device attached above the grinding wheel head, was used for the tests. The conical diamond was mounted in a holder on the grinding wheel shaft. This shaft, in turn, was connected to the copying slide onto which a template follower was fixed. The copying slide was set to an angle of 30 deg and two polished wedge-shaped diamonds were used as truing tools. The profile grinding wheel of corundum "K" hardness type with grain size of 120, was operated at circumferential speed of 5600 fpm. A Leitz-Forster surface measuring instrument was used and the wear of the diamond was recorded photographically.

Optimum Lot Size

An analysis to determine the optimum size of production lots will be found in an article by J. Duerst, published in the Swiss periodical *Industrielle Organisation*, Vol. 27, No. 5. The title of the article is "Optimale Losgroesse. Die Berechnung der optimalen Losgroesse fuer Lageraufgabe bei gleichmässigem Lagerabbau."

This thorough study, with mathematics, covers cost, investment, overhead, interest rates, number of manufactured and stored items. The effect of bottlenecks is also taken into consideration, as well as wages and cost of management. It concludes with the development of a "lot-size coefficient." Effect of scrap is considered as a probability function in a more general formula which is presented graphically.

Auomatic Control of Machine Tools

A method for controlling machine tools by feedback from the dimensions of the workpiece is described by K. Hauser in *Industrie Kurier*, 1958, Vol. 11 (6), pp. 59-60 under the title: "Messteuerungen an spanabhebenden Werkzeugmaschinen." The author discusses centerless grinders, surface grinders, jig boring machines, copying and automatic lathes.

Another article on the same topic was published by A. Forster in *Industrie Anzeiger*, 1958, Vol. 80 (16-17), pp. 221-225 under the title: "Das Messen in der Maschine." This article is based on the author's talk given before the meeting on automation held at Stuttgart, West Germany. He indicates that automation depends on accurate measurement during grinding, and that very precise measurements are taken at a single point by means of a diamond edge which is applied and withdrawn electromagnetically. A pneumatic recorder takes readings to an accuracy of a fraction of a micron (0.000040 inch).

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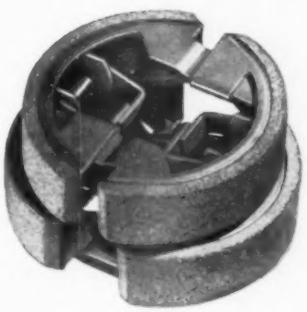
NEW Jarvis

"TORQOMATIC" TAPPING HEADS



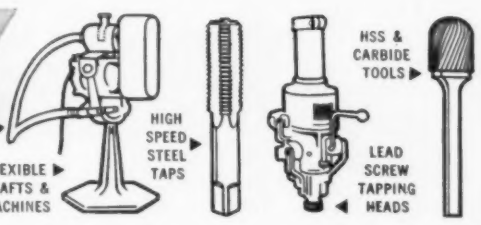
Here is the new Jarvis "Torqomatic" tapping attachment—completely redesigned inside and out! The rugged magnesium body now houses a unique clutch with "straight-line" action . . . response to fingertip pressure on the drill press handle is instantaneous.

Jarvis Torqomatics are tortionally-driven and may be run at optimum speed for the material being tapped. Because it operates with the least amount of pressure on the tap itself, a Torqomatic keeps tap wear and breakage at a minimum . . . produces accurate threads hour after hour.

Slightest pressure of the tap against the work causes the clutch to be fully engaged. Straight-line action of this new clutch provides a 100% driving surface, eliminates any slippage. This basic design feature results in twice the power of the former model, with clutch life more than doubled.

Torqomatic tapping heads are available in 9 standard models, with chuck capacities of 3/16", 3/8", or 5/8". They can be furnished to fit any drill press or tapping machine. For a real demonstration of tapping speed, accuracy and trouble-free performance, get in touch with your Jarvis representative!

Jarvis



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good READING

CONTROL ENGINEERS' HANDBOOK—*Edited by John G. Truxal. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $18.50. 1150 pages.*

The growing use of automatic equipment in all types of industry necessitates a continued search for novel and special applications of controls. This book contributes to the control engineer's store of available knowledge on control components and their application. Assimilating the ideas of 36 experts in their respective fields, this book is a basic source of information for use in the design of feedback control systems. It contains a comprehensive discussion about many types of components including electromechanical, mechanical, hydraulic, pneumatic, electronic and magnetic.

In addition to reviewing the operation and function of controls, the assembly of the components into systems is also covered. Mathematic analyses are given for the various components to help the engineer in the design of control systems.

LEGAL PROBLEMS IN ENGINEERING—*By Melvin Nord. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price $7.50. 391 pages.*

All engineers, in any capacity, should be aware of the bounds surrounding their profession. Written by a lawyer-engineer, this book uses layman's terms to explain what an engineer can or cannot, should or should not, do.

The book contains easily understandable discussions of contracts, sales, insurance, agency and business organizations among a complete list of legal points affecting the engineer in business. There are sections covering an engineer's ethical responsibility, professional registration and a discussion

of engineering legal problems.

Writing in the book is neither pure textbook nor pure casebook style. Both techniques are used to supplement the other for a more lucid presentation of the subject.

WHO MAKES MACHINERY?—*Buyer's Machinery Guide, 1958. Edited by Association of Germany Machinery Mfrs. Available from Nordeman Publishing Co., Inc., 14 E. 62nd St., New York 21, N. Y. Price $3.50. 800 pages.*

This directory lists the West German suppliers of machinery, equipment and precision tools, product classifications and manufacturers. There are thirty-seven groups into which the products are divided, e.g., machine tools, industrial furnaces, foundry machinery, etc. Each main grouping has sufficient subgroups to describe the products adequately for easy reference.

PLANT ENGINEERING PRACTICE—*By the editors of Plant Engineering magazine. Published by F. W. Dodge Corp. in cooperation with the Technical Publishing Co., New York, N. Y. Price $18.50. 694 pages.*

This book is a compilation of selected articles on all the phases of plant engineering. Data is available on the selection of the sites for plants, construction, safety, materials handling, maintenance, utilities and services and shopwork. It has been organized for easy reference to facilitate finding the information desired on a particular phase of plant operations.

HANDBOOK OF ELECTRICAL DISCHARGE MACHINING—*Edited and Published by Elox Corp. of Michigan, 1830 N. Stephenson Hwy, Royal Oak 3, Mich. Book I—Applications for Industry, 133 pages; Book II—Equipment and Accessories, 68 pages; Book III—Theory and Applications, 47 pages. Price $5.00 per book; $15.00 per set.*

Data on the electrical discharge machining (EDM) process has been compiled by Elox to acquaint engineers and management with the potentials of the process. Actual case studies have been outlined to illustrate the versatility, cost savings and application of EDM. Theory and recommended procedures for the use of the process are covered in easily understandable terms to permit the direct use of the information in the shop.

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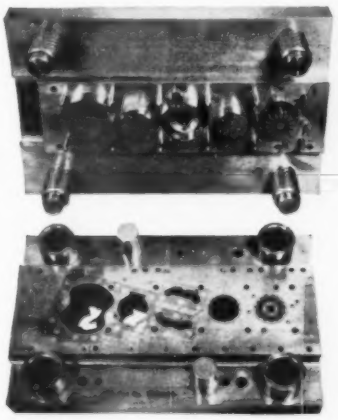
CLEVELAND TOOL and DIE COMPANY SOLVES YOUR PROBLEMS and meets your most exacting tool and die requirements. Cleveland Tool and Die Company has built individual dies which have produced millions of precision tolerance pieces without retooling. SEND FOR THIS FREE BROCHURE DESCRIBING OUR FACILITIES.



FREE Brochure

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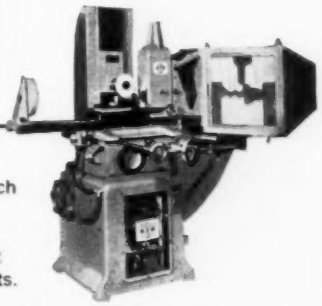

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who's meeting and where

Sept. 29-Oct. 3. American Society of Tool Engineers. Western Tool Show and Conference, Shrine Exposition Hall, Los Angeles, Calif. All details are available from Society headquarters, 10700 Puritan Ave., Detroit 38, Mich.

Oct. 1. Society of Plastics Engineers, Inc. Western New England Section. Regional Technical conference on "Plastics in Packaging," Hotel Statler, Hartford, Conn. For more data contact Blakely R. McNeill, c/o The Fuller Brush Co., 3480 Main St., Hartford, Conn.

Oct. 13-15. American Institute of Electrical Engineers. 10th National Machine Tool Conference, Statler Hilton Hotel, Hartford, Conn. Advance registrations may be made with William P. Carpenter, chairman of registration committee, c/o Superior Electric Co., 83 Laurel St., Bristol, Conn.

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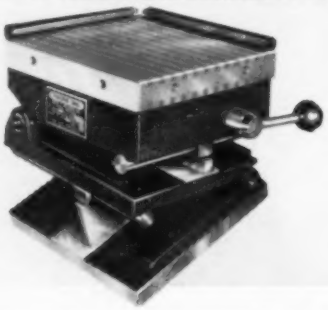

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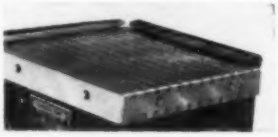

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Oct. 13-15. National Electronics Conference. 14th annual conference, Hotel Sherman, Chicago, Ill. For further information, write program committee chairman, L. W. Von Tersch Electrical Engineering Dept., Michigan State University, East Lansing, Mich.

Oct. 14-16. American Society of Mechanical Engineers. Lubrication—ASLE conference, Statler Hotel, Los Angeles, Calif. Pertinent data may be had from society headquarters, 29 W. 39th St., New York 18, N.Y.

Oct. 16-17. Illinois Institute of Technology *and* Armour Research Foundation. National conference on industrial hydraulics, Hotel Sherman, Chicago, Ill. Address inquiries to Conference Coordinator, IIT, 3300 Federal St., Chicago 16, Ill.

Oct. 21. Society of Plastics Engineers, Inc., Upper Midwest section. Regional technical conference on epoxies, Curtis Hotel, Minneapolis, Minn. Chm. Russell B. Kirby, Jr., c/o Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul Minn. can supply full data.

Oct. 21-22. Purchasing Agents Association of Chicago. Purchasing Workshop sponsored by Illinois Institute of Technology, Dept. of Business and Economics, 33rd and State St., Chicago. Get other data from association office, 134 N. LaSalle St., Chicago 2, Ill.

Oct. 23-25. Fluid Control Institute. Fall Meeting, Drake Hotel, Chicago, Ill. Write for complete data to R. McCormick, Public Relations Committee, Fluid Controls Institute, c/o Automatic Switch Co., Florham Park, N.J.

Oct. 23-25. National Society of Professional Engineers. Fall meeting, St. Francis Hotel, San Francisco, Calif. For details, contact society headquarters, 2029 K St., N.W., Washington 6, D.C.

Oct. 24. Society of Plastics Engineers, Inc., Golden Gate section. Regional technical conference on plastics and electronics. For more data contact Golden Gate President, Julius W. Palen, c/o Lenkurt Electric Co., San Carlos, Calif.

Oct. 27-31. American Society for Metals. National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland, Ohio. Complete facts may be had from society office, 7301 Euclid Ave., Cleveland 3, Ohio.

Oct. 28. Ultrasonic Manufacturers Association. Annual meeting, Hotel

Cleveland, Cleveland, Ohio. Association office, 271 North Ave., New Rochelle, N.Y., can supply more information.

Oct. 29-30. ARMOUR RESEARCH FOUNDATION. Computer applications symposium, Morrison Hotel, Chicago, Ill. All facts are available from the Conference Secretary, Armour Research Foundation of Illinois Institute of Technology, 33 10 W. 35th St., Chicago 16, Ill.

Oct. 29-31. METAL TREATING INSTITUTE. Annual meeting, Hotel Cleveland, Cleveland, Ohio. All information may be obtained from institute office, 271 North Ave., New Rochelle, N.Y.

Oct. 22-24. THE AMERICAN SOCIETY OF BODY ENGINEERS, INC. 13th annual technical convention, Rackham Memorial Bldg., Detroit, Mich. For complete details, contact society office, 100 Farnsworth, Detroit 2, Mich.

Oct. 30-Nov. 1. AMERICAN SOCIETY FOR METALS. Seminar on Residual Stresses, Cleveland, Ohio. For information on program and registration, contact ASM office, 7301 Euclid Ave., Cleveland 3, Ohio.

Nov. 5-7. PORCELAIN ENAMEL INSTITUTE. Shop Practice Forum, University of Illinois and Urbana Lincoln Hotel, Urbana, Ill. Institute office, Associations Bldg., 1145 Nineteenth St., N.W., Washington, D.C. can supply facts.

Nov. 5-9. NATIONAL TOOL & DIE MANUFACTURERS ASSN. Annual convention, Sheraton Hotel, Philadelphia, Pa. For more information, write association office, 907 Public Square Bldg., Cleveland 13, Ohio.

Nov. 6. SOCIETY OF PLASTICS ENGINEERS, INC., Philadelphia Section. Regional technical conference on "Advances in Injection Molding." Request more facts from society office, 65 Prospect St., Stamford, Conn.

Nov. 10-12. STEEL FOUNDERS' SOCIETY OF AMERICA. 13th technical and operating conference, Carter Hotel, Cleveland, Ohio. Society headquarters, 606 Terminal Tower, Cleveland 13, Ohio, can supply complete information.

Nov. 17-21. SOCIETY OF THE PLASTICS INDUSTRY, INC. National Plastics Exposition, International Amphitheatre, Chicago, Ill. Get details from society office, 250 Park Ave., New York 17, N.Y.

Nov. 30-Dec. 5. THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual meeting, Statler and Sheraton-McAlpin hotels, New York City. For more information write society office, 29 W. 39th St., New York 18, N.Y.

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says E. J. Friebele, Chief Engineer, L. H. TERPENING CO.

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Tech Digests

Optical Tooling

uses in industrial plants

By H. R. Osmick
Engineering Dept.
E. I. du Pont de Nemours & Co., Inc.
Wilmington, Del.

and

J. L. Hanold
Technical Instrument Div.
Keuffel & Esser Co.
Hoboken, N. J.

ALTHOUGH the alignment problems found in other industries may seem to differ completely from those of the airframe manufacturers, the vast majority of these problems, both in and out of the aircraft industry can be reduced to finding the answers to four fundamental questions:

1. Is it straight?
2. Is it flat?
3. Is it plumb?
4. Is it square?

Actually it doesn't matter whether it is a do-it-yourself project at home, the installation and maintenance of equipment in your plant, or quality control and assembly of manufactured units; these four questions must be answered. Obviously, the answers need not always be to the same degree of accuracy, and in optical tooling we are primarily concerned with alignments involving tolerances that are measured in thousandths of an inch and seconds of arc.

However, greater accuracy is not the only advantage of optical tooling. Occasionally, optical tooling is purchased because there is no satisfactory alternative method available, but usually it is bought simply because the customer is convinced that optical tooling will save him money. Part of the savings may be a result of the better alignment, but a substantial amount is often due to a reduction in manhours required to accomplish the alignment.

In the shipbuilding industry, optical tooling is being used to align shaft bearings, establish witness lines for boring operations, and controlling the shipboard machining of steam catapults. During the installation of large paper machines, the sole plates are leveled and the crosslines for the erection of columns are laid out on the sole plates using optical tooling. Because of the leveling accuracy obtained, the top surface of the sole plates and the bottom surface of the columns are machined at the factory. No shims or other adjustments are required in the field. A similar method is used to check and realign cylinders on any type of machinery, *Fig.* 1, requiring a series of cylinders all to be mutually perpendicular to the longitudinal center line of the machine, as shown in *Fig.* 2.

Manufacturers of machine tools are using optical tooling to align machines during manufacturing as well as during final erection in the customers shops. In addition, many shops are using optical tooling for periodic maintenance checks on their machine tools and for gaging completed products. The electronics industry uses optical tooling to set up accurate test fields in order to align the mechanical axis to the electronic axis of radar units.

These are just a few of today's applications. Actually, with a firm understanding of the principles of optical-alignment procedures, the engineer can save his firm considerable sums of money through faster and more accurate alignment with optical tooling.

The accuracy of component parts is controlled by the alignment of the machine tool producing them. Thus, it is often necessary to check and align machine tools on which these close-

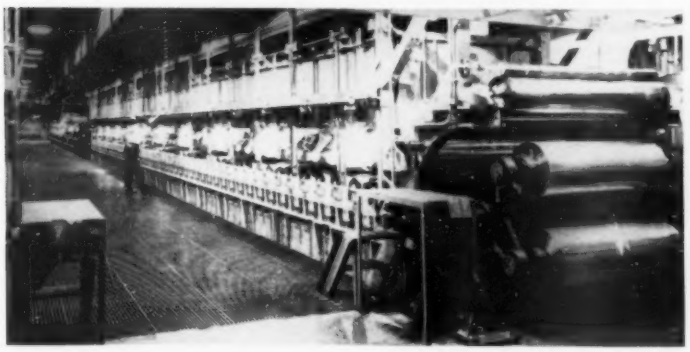

Fig. 1. Cellophane casting machine for the continuous extrusion of the ripened viscose to form sheets. These sheets are passed over rolls through several baths to wash, harden, bleach, plasticize and dry it.

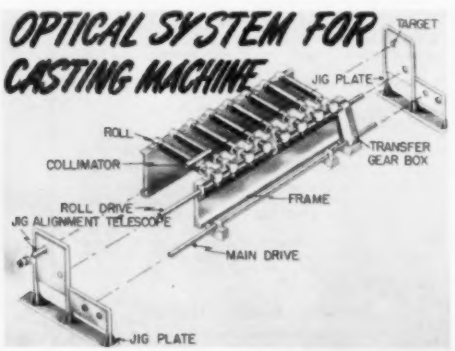

Fig. 2. Optical system used for this alignment of the 200 ft cellophane casting machine. Special jig plates and targets reduce the setup time.

tolerance parts are to be produced.

Fig. 3 illustrates the method used to align a lathe. The method involves two parts:

1. Leveling of the bed.
2. Aligning of the bed true to the axis of rotation of the spindle.

Part one involves the use of a precision tilting level to locate both ways of the bed at the same elevation. Part two involves the use of a collimator, target, and jig-alignment telescope to align the spindle to the bed. The telescope, mounted on an adjustable stand located at the tailstock end of the lathe, is bucked into a collimator fitted into a prebored cylinder held in the lathe chuck. (The term "bucked" means moving the scope sight line into the same elevation, line, and parallel to the collimator sight line.) A target mounted on the tool post, adjusted to the optical line at a position near the chuck, is read at frequent intervals as the carriage is moved along the bed.

Fig. 4 shows a set of before-and-after readings so obtained. The readings indicate the misalignment between the axis of rotation of the spindle and the bed. Misalignment, in the vertical plane of 0.060-inch maximum is corrected by adjusting the end jacks under the head and misalignment in the horizontal plane of 0.0243-inch maximum by raising the jacks under the back way.

As can be seen, the vertical misalignment was corrected to within 0.0053 inch at the tailstock end. The horizontal alignment was corrected to within 0.005 inch. For our purposes, the vertical alignment was of much less importance than the horizontal alignment.

The optical method has two distinct advantages over older conventional methods; greater accuracy and reduced alignment time. Also, the optical method is the only known procedure that can be used to align the spindle accurately for the full length of the bed.

The application of optical tools to the alignment of production equipment has many benefits. Among these are better alignment, reduced alignment costs, improved operating performance and reduced maintenance. However, increased benefits can be obtained by designing equipment to receive optical tools. Not only is the original installation of the equipment more accurate and faster but the alignment may be checked for maintenance without long shutdowns. For instance, a special hydraulic press recently fitted with optical facilities can be completely checked for alignment in 20 minutes without removing a single part. Periodic checking and realignment are extremely important for after only a short period of experience with optical tools it is possible to discover the inevitable movement of concrete and steel.

There are also cases where intentional misalignment is desirable. Machines included in this group are, steam turbines, centrifugal compressors and extrusion presses where elevated temperatures and/or pressures are present. That is to say, the machine is purposely misaligned when cold from known recorded data so that it is in alignment when operating.

One more desirable feature in the design of equipment is the inclusion of leveling and adjusting devices through which alignment may be obtained readily and precisely. Incidentally, on lighter equipment destined to be optically aligned it is unnecessary to provide bed plates. Equipment can be located on studs held in concrete and grouted in. Thus, the cost of fabricating and locat-

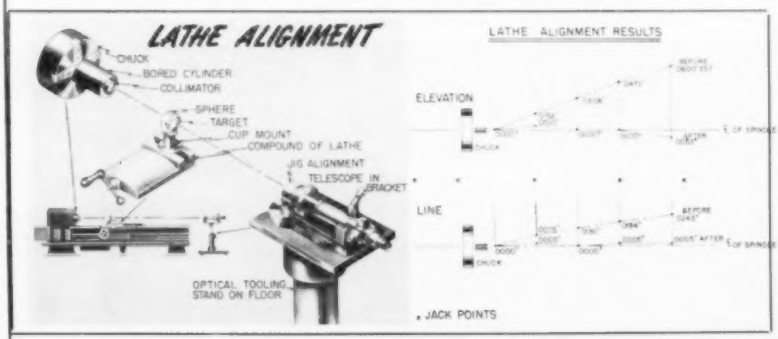

Fig. 4. Results of a lathe alignment check using the method illustrated in Fig. 3. Vertical misalignment was corrected within 0.0053 inch at the tailstock end.

Fig. 3. The method used to align a lathe for precision machining operations. The bed of the machine is leveled and is aligned true to the axis of rotation of the spindle.

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INDICATE A-10-190

ing base plates can be eliminated.

Each alignment job requires not only optical instruments but facility gages peculiar to the machine. These facility gages are not inexpensive since they are as indicated—gages having close tolerances. As experience in alignment work continues to expand, the need for additional instruments such as one for the squaring of rolls will be developed to decrease the cost of facility gages.

From the cases cited, it is evident that optical tooling is at present playing an important role in the alignment of existing and new production equipment within the du Pont Company. Beyond its first use in this country by the aircraft industry, only a fraction of the potential of optical alignment has been utilized. The future of optical alignment is limited only by the imagination of the engineers who plan its application. A hint of this future may be visible in the European standard machine tools now available with built-in optical measuring devices. It is quite possible that future equipment will be available from the vendor complete with facilities for optical alignment. Thus, the purchaser of such equipment will benefit through the reduced cost of installation and subsequent maintenance and better operating performance.

From a paper presented at the Maintenance and Plant Engineering Conference of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

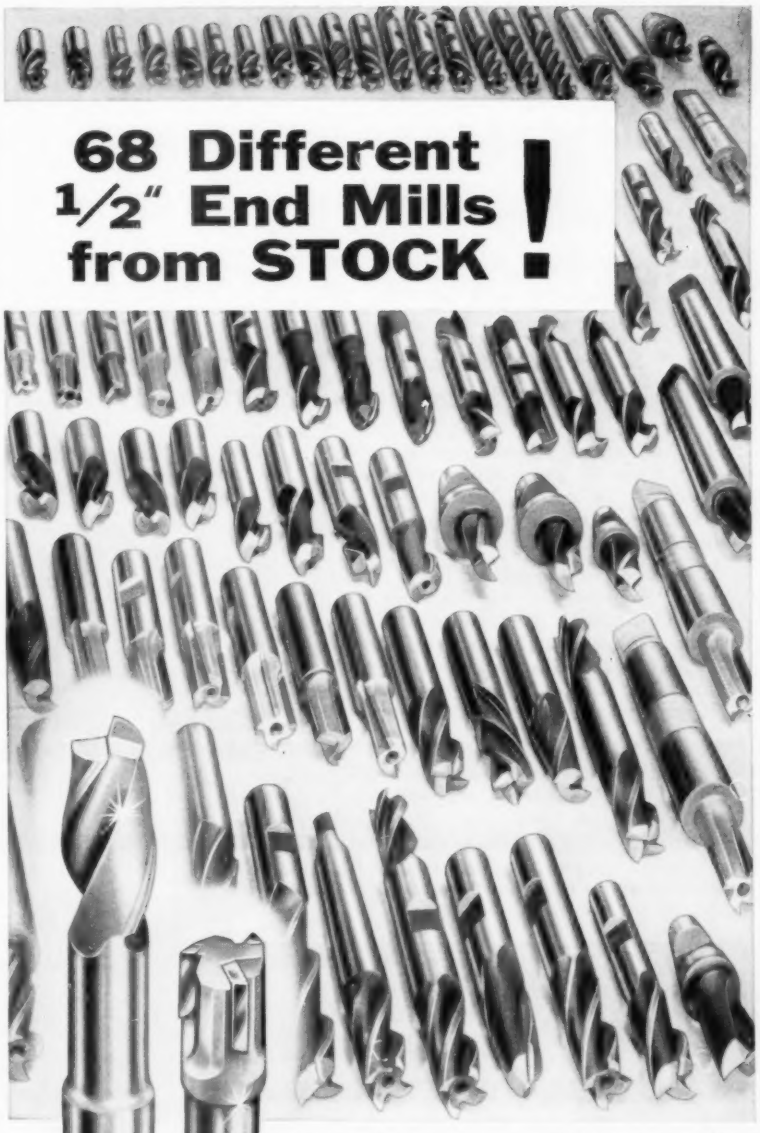
TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

An "In-Plant" Gear Education Program

By Paul J. Leeser

Asst. Purchasing Agent
G & L and Hypro Div.
Giddings and Lewis Machine Tool Co.
Fond du Lac, Wis.

The old saying, ascribed to Mark Twain, that everybody talks about the weather but nobody does anything about it can sometimes be applied to other topics which are on occasion in the limelight among current events; for example: the often discussed shortage of engineers, scientists and technicians. This shortage is not of as recent an origin as we may be led to believe. It



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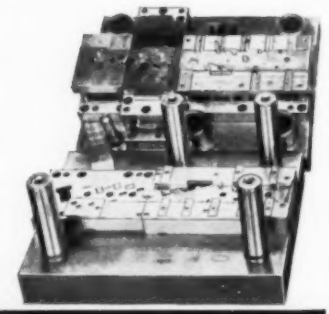
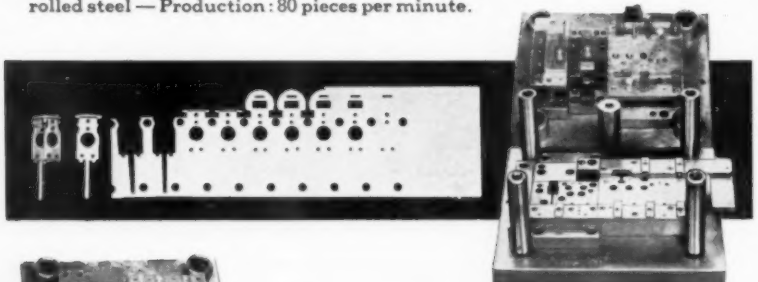
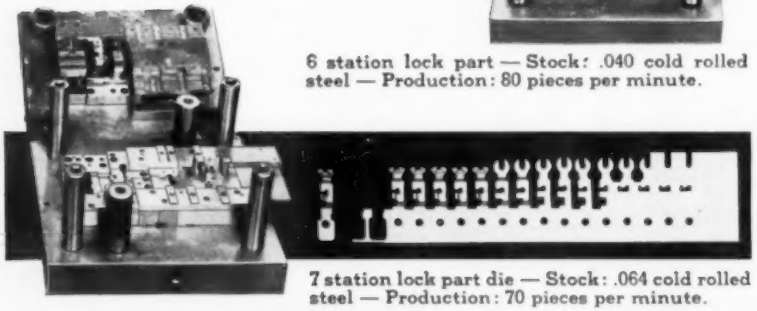


8 station progressive die — Stock: .040 cold rolled steel — Production: 80 pieces per minute.



6 station lock part — Stock: .040 cold rolled steel — Production: 80 pieces per minute.



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probably existed when the Chinese built their great wall and when the Romans built their roads. It certainly existed at all instances of past international crises, when there was fear or proof that the competitor or "enemy" had better trained people. And then our learned ancestors talked about the shortage, and perhaps thought they did something about it, only to find out that at the next danger signal from abroad the lack of properly trained people was more severe than before.

To fill our need for gear men, as well as most other skills in critical demand, more and more education is the obvious answer. We've suddenly learned, as we could have learned fifteen years ago, had we chosen to come out of our secure shell, that Russian education has been stepped up until from some viewpoints it seems better than ours. Their youth is flocking into science and engineering courses, and is also given heavy doses of languages, humanity and general education. Our educators are still arguing whether to yield to pressures of more specialized education, or whether to yield to the proponents of "broad" education. Obviously, both are needed.

How are we going to do this? Have more classes in science and mathematics started a lot earlier in school. Augment and lengthen the school year, and the number of years in formal education, in public school as well as college.

In the interim, and perhaps forever, we as individuals and as men of industry must find means of filling the gap. We have very little time to operate, because we are constantly behind. By instituting "in plant" training programs in those areas where public education is not available, we can take a big step towards helping ourselves.

Based on a paper presented at the Annual Meeting of the American Gear Manufacturers Association, One Thomas Circle, Washington 5, D. C.

▼ ▼ ▼

Research is Everybody's Business

By Dr. A. V. Astin

Director
National Bureau of Standards
U. S. Dept. of Commerce

The most obvious way for a company to attain a sound competitive technological position is to have a staff of quali-

fied scientists or engineers. If the staff has sufficient competence and initiative it not only can support the achievement of more marketable products for the company, but may also compete for some of the nation's research and development business as well. Many of the requirements of the Department of Defense are filled by small business. If the size of the operation does not warrant any investment in technical staff then recourse should be made for qualified assistance elsewhere. There are many private research laboratories established to provide technical assistance to industry. The National Science Foundation has recently published a directory of these. Many colleges and universities provide such assistance; there is an increasing number of consulting scientists and engineers, including many college faculty members, who seek such work on a part-time basis. There are also numerous instances of business associations with common problems pooling their resources to obtain technical advice and research assistance. The need is to recognize the value of research to productivity and to take steps to insure technological progress.

As a minimum requirement, a key official of the company should be assigned the responsibility of following the technological changes in those areas relevant to the company's business. Many of the reports of the Department of Commerce will be helpful in serving company officials with such an assignment. In addition, the trade journals will contain pertinent and current technical literature.

Opportunities to benefit from research begin with a state of mind—that of being receptive to progress change. If there is a sufficiently strong desire to improve, to do things better than they are being done today, then a most critical obstacle will have been overcome. With such a point of view one becomes research-minded and the acquisition of facilities to participate in technological progress becomes more or less a matter of course. This forward-looking point of view will lead to a greater appreciation of the broad aspects of technological progress including its dependence on all types of research. A greater appreciation of the role of research in our economy is a prerequisite to assuring continued peace and increasing prosperity.

Based on an address at the Corvallis Conference on Research and Development for Small Business, Corvallis, Ore.

Cermet Control-Rod Fabrication By Powder Rolling

By Samuel Storchheim
Pres. & Technical Director
Metals Research & Development, Inc.
Exeter, Pa.

Many difficulties encountered during the fabrication of control rods made of B_4C in stainless steel, Eu_2O_3 in stainless steel and B_4C in aluminum are avoided by use of a new fabrication technique, namely, rolling powder mixtures into strip. The information on the process is unclassified and the latest obtainable.

There are a considerable number of advantages to the use of metal powder rolling. Just a few of these which can be associated directly with nuclear work are the following:

1. No expensive dies or long lead times for the fabrication of these dies are required; only the rolls of a standard rolling mill are needed.
2. Particle dispersions in the cermet are extremely uniform.
3. If required, this method offers the advantage of no stringering or fracture of the dispersed particles.

SOSSNER

3 SOSSNER exclusives

1. SOSSNER TRIPLE TEMPERED TAPS

Only SOSSNER Taps are tempered THREE TIMES. This results in a tougher, more reliable, longer lasting tap.

2. SOSSNER SPIRAL TAPS

A choice of 3 standard designs for wider application.

Regular
Hook
Three Flute

3. SOSSNER "elektraLUBE" SURFACE DEPOSIT

"elektraLUBE" provides super lubrication at critical pressure points A & B where conventional lubricants stop functioning.

Quality Controlled Since 1910

Since its founding in 1910, SOSSNER has earned an industry-wide reputation for high performance and reliability of product through adherence to a strict Quality Control Program. As an example . . . all SOSSNER Taps are subjected to final inspection procedures of 100% on critical dimensions, and 200% on thread size. SOSSNER stocks a complete line of standard taps in all sizes and styles. Custom or Special tap orders receive prompt, knowledgeable handling by our tap specialists.

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Inquiries from representatives and distributors are invited.
Factory Warehouses In New York and Los Angeles
Dealer Stocks In Other Cities

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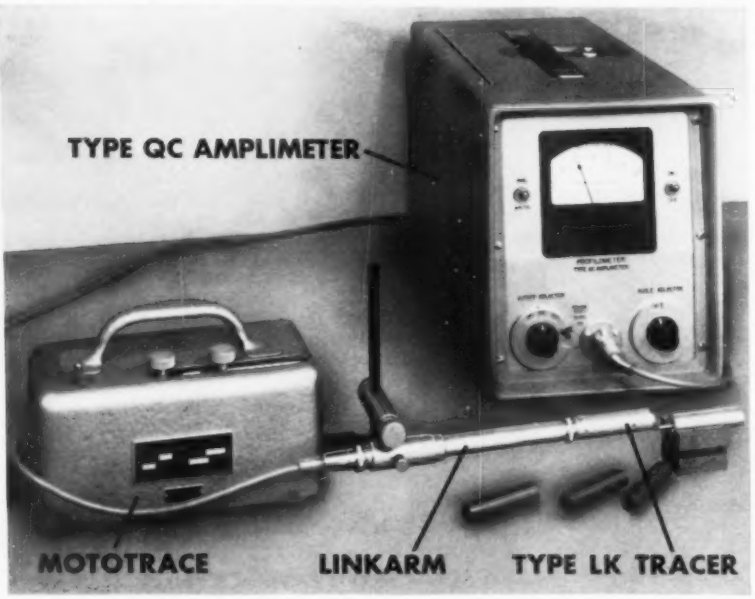
NEW! Profilometer® GROUP III



Measures Roughness of Surfaces from 1/8" to Flat — ID and OD

THIS shop equipment handles an exceptionally wide range of roughness measurement—with *proven Profilometer accuracy.* It is lightweight and portable — built for use by shop personnel — and includes the following items:

NEW Type LK Tracer — Measures on ID's and OD's as small as 1/8" — flats — tapers — narrow splines — gear teeth. Passes through a 3/4" hole.

NEW Type QC Amplimeter — Shows roughness from 0 to 1000 microinches (arithmetical or r.m.s.) on an easy-to-read meter. Has 3 standard roughness width cutoffs. Factory-calibrated for dependability.

Mototrace and Linkarm — Give the Tracer a steady support and smooth motion, essential to dependable measurement. No operator skill required.

FREE LITERATURE gives details. Write for it. And, without obligation, let us arrange for a demonstration in your plant. We have representatives in principal industrial centers throughout the Free World.

Remember: You can DEPEND on the PROFILOMETER — first in surface roughness measurement since 1936.

Profilometer is a registered trade-mark.

MMC® MICROMETRICAL MANUFACTURING COMPANY

349 S. MAIN ST. ANN ARBOR, MICHIGAN

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4. Strips of the control rod material can be made almost to size. If thick components are required, the strips can be conveniently stacked.
5. Very high weight percentages of refractory materials can be incorporated into the cores of such components.
6. Green strip emerging from the rolls is very strong and can be readily handled. The technique utilizes pressure with great efficiency such that minimum heat-treating temperatures and times can be utilized.
7. The technique can be adapted to produce multilayer configurations, as well as the complete simultaneous cladding and fabrication of the core.

Some of the technical results obtained regarding the powder rolling of cermet control rod combinations are as follows:

1. Densities can be as high as 95 to 99 percent + of theoretical.
2. Particle dispersions are extremely uniform. Normally the higher the magnification, the poorer the dispersion appears. Even at 600X magnifications the dispersions appear to be quite good. It is interesting to note that as-received submicron sized Eu_2O_3 powders were dispersed very successfully without the necessity of firing and grinding the particles to greater size.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

3. The higher the quantity of contained hard particles, the lower is the characteristic metallic ring. In fact, 25 v/o europium oxide in stainless steel has a considerable deadening affect. This comes about from the fact that the oxide particles completely surround the stainless steel matrix particles. As a speculation this might be an interesting method for the production of vibration dampening materials.
4. Scrap losses for the process have been found to be quite low. In the fabrication of a small production quantity of stainless steel plus europium oxide specimens, total oxide losses for the entire operation were held to less than five percent. (Firing and grinding of the oxide would add another 5 to 10 percent if these steps were to be incorporated in the processing cycle.)

Based on a paper presented at the Nuclear Engineering & Science Conference, Chicago, Ill. Published on behalf of Engineers Joint Council by the American Institute of Chemical Engineers, 25 W. 45 St., New York 36, N. Y.

Are your lathes designed to profit from throwaway insert tools?

PROFIT POINT TURNING

Real profits come from decreased tool-change downtime and increased machine speeds

You can take full advantage of the savings made possible by throwaway insert tooling — elimination of sharpening and resetting costs, and decreased tool-change downtime — if you have a modern, high-speed lathe designed for carbides and ceramics. Chances are savings in tool-replacement costs plus greater production due to higher speeds and increased rigidity will amount to thousands of dollars a year, enough to pay for the new lathes you need badly to take full profit advantage.

The use of conventional speeds with throwaway insert tools is *wasteful.* And your profits are pegged *low* if you're using them on 20-year-old lathes that are underpowered for high-velocity turning. With perishable-tool costs so low in comparison with the cost of operating a lathe, the only sensible thing to do is boost machine speeds . . . burn up the cutting tool faster . . . really trim the fat out of the part price.

The speed at which tool costs and machining costs are in balance is your PROFIT POINT (see example above). But to operate at the right speed you need power, precision, and rigidity in lathes used with throwaway insert tooling—advantages your company will be glad to pay for in order to save time, floor space, and cost.

In other words, why put throwaway insert tooling on a "throwaway profit" machine tool?

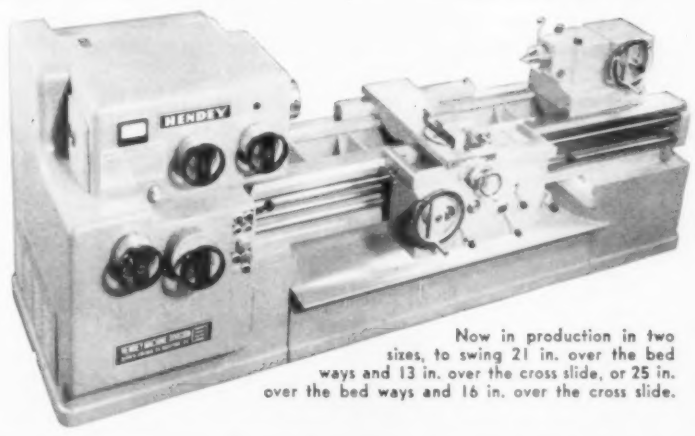
Example of PROFIT-POINT Turning		
Cost Item	Brazed Carbide	Throwaway Insert
Tool-change time	5 min.	2 min.
Cost per cutting edge	$1.27	$.25
Minimum cost tool life	40.4 min.	11 min.
Cutting speed for PROFIT-POINT turning	720 fpm 1000 rpm	980 fpm 1360 rpm
Machining time per piece	1 min.	.74 min.
Total time per piece (including nonproductive time per piece)	2 min.	1.74 min.
Machining cost per piece	$.15	$.11
Total cost per piece	$.031	$.017
Nonproductive cost per piece	$.15	$.15
Pieces machined per hour	30	34
TOTAL COST PER PIECE	$.331	$.278

Barber-Colman's new 36-speed lathe is designed for PROFIT-POINT turning

Here's the machine that will give you precision work at the high speeds required for PROFIT-POINT turning with throwaway insert tools!

Look at the cross girth of the bed, extra-heavy cross slide, and rugged tailstock. Consider that this lathe will pull up to 25 hp through the spindle and operate at speeds up to 2000 rpm — yet you can get toolroom accuracy. And all the toolroom features, too, including: (1) multiple-thread indexing spindle, (2) built-in thread-chasing dial, (3) 66 threads, from 2 to 120 per inch, (4) reverse lever on apron, (5) automatic micrometer stops, (6) ball-thread-chasing stop on cross-feed screw, (7) hardened and precision-ground cross-feed screw and compound screw, (8) automatic, filtered lubrication to half nuts.

There are 36 spindle speeds through the geared head and 66 feed and thread changes, selected easily through two dials on the headstock. Write for complete facts on how this new Barber-Colman precision lathe will pay for itself quickly with throwaway insert tooling.



Now in production in two sizes, to swing 21 in. over the bed ways and 13 in. over the cross slide, or 25 in. over the bed ways and 16 in. over the cross slide.

Barber-Colman Company
103 Loomis Street, Rockford, Illinois

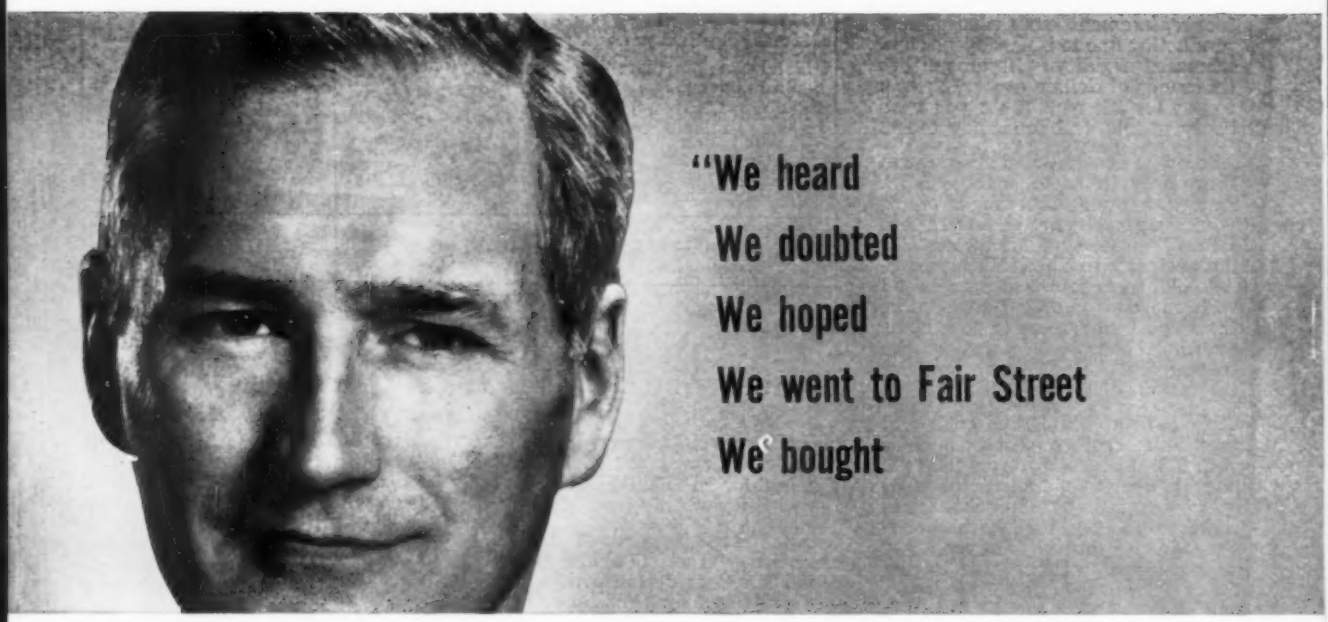
Don't expect a day's work for a day's pay on yesterday's machine tools

BARBER COLMAN

PRECISION LATHES

C. J. GANO, Vice-President & Plant Manager,
Speco Division, Kelsey-Hayes Co.

a man who came to Fair Street



"Two more DeVlieg JIGMILS rapidly followed the first. Continued proof of precision, speed and versatility caused us to buy an additional two machines.

With our JIGMILS we no longer use an expensive machine as a planning desk. We no longer build expensive boring fixtures. The JIGMIL Technique solves these problems and saves both time and scrap.

Our DeVlieg JIGMILS give us the versatility needed in our 'Overgrown Job Shop.' We can make prototypes with the same accuracy as tooled jobs and continue our production without expensive retooling and loss of time."

C. J. GANO

DE VLIEG MACHINE COMPANY, FAIR STREET • **ROYAL OAK, MICHIGAN**

SOME OF OUR JIGMIL USERS

Adams Div., LeTourneau-Westinghouse Co.
Akron Standard Mold Co.
Allen Tool Corp.
American Machine & Foundry Co.
Andale Company
Baker-Perkins, Inc.
Bell Aircraft Corp.
Bendix Products Div. of Bendix Aviation Corp.
Bryant Chucking Grinder Co.
Buick Motor Div., General Motors Corp.
J. I. Case Co.
Cleveland Trencher Co.
Danroy Boring Co.
Daystrom Inc.
Denison Engineering Div. American Brake Shoe Co.
Eclipse-Pioneer Div., Bendix Aviation Corp.
Emsco Manufacturing Co.
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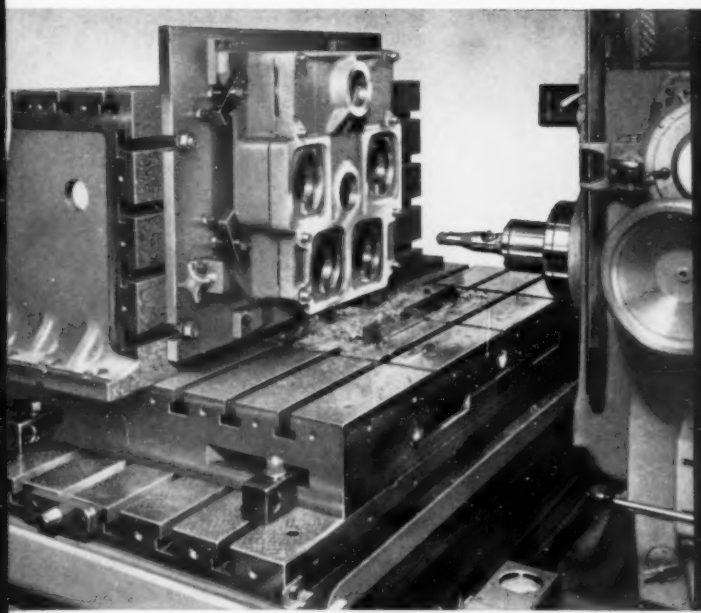
Fenn Manufacturing Co., The
R. H. Freitag Mfg. Co.
Goodyear Tire & Rubber Co., Inc.
Halliburton Oil Well Cementing Co.
Heintz Div. Kelsey-Hayes Co.
Hughes Tool Co.



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

ANOTHER EXAMPLE OF JIGMIL PRECISION
applied to guided missile production

Speco Division, Kelsey-Hayes Co., uses the JIGMIL Technique to bore and mill to precise limits of accuracy a wide range of guided missile components such as the one above. Because of their speed, accuracy and versatility, Speco also uses its 5 JIGMILS in the production of such critical items as aircraft and helicopter transmissions, hydraulic control systems, radar antennas, rocket and jet engine precision gears and assemblies.

Improved Paper Machinery Corp.
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Oil Well Supply Div. U.S. Steel Corporation
Paramount Boring & Machine Co.
Princeton University, Forrestal Research Center
Rheem Mfg. Co.
Sandia Corp., Sandia Base, U.S. Atomic Energy Comm.
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Teppert Tool & Eng., Inc.
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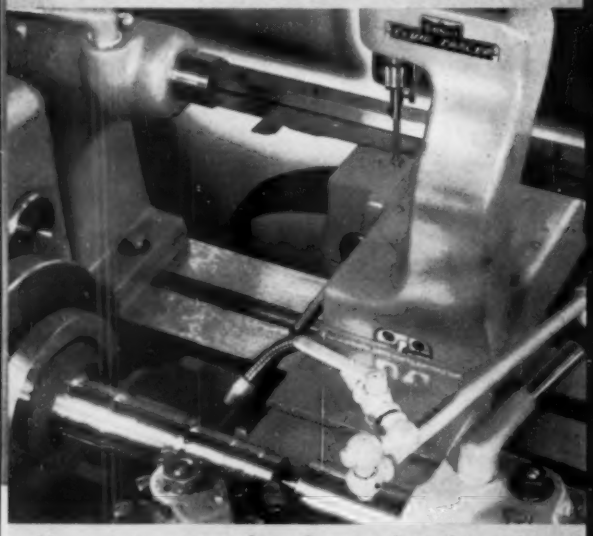
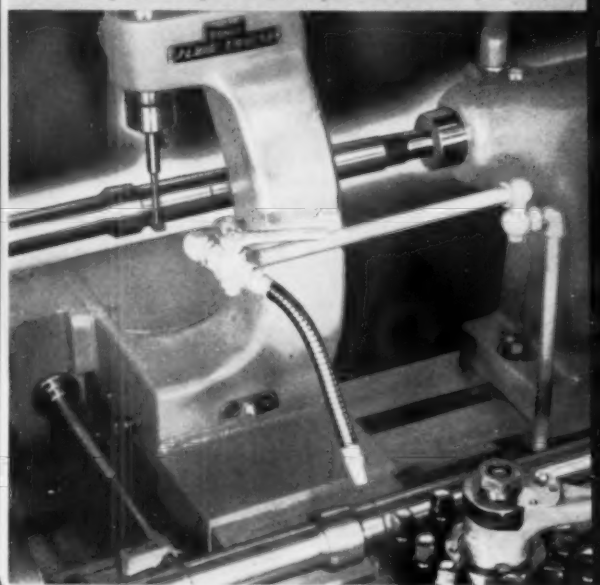
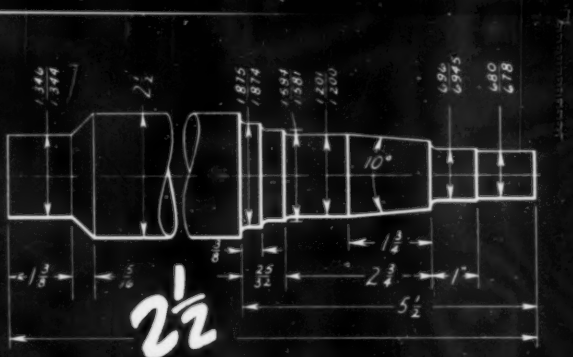
ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

Interrupted cuts don't bother Sidney lathes. Time saved on this job was over 2 hours per piece.



You can tracer-turn from flat templates (above) or from a previously machined part or master (below).





2½ MINUTES

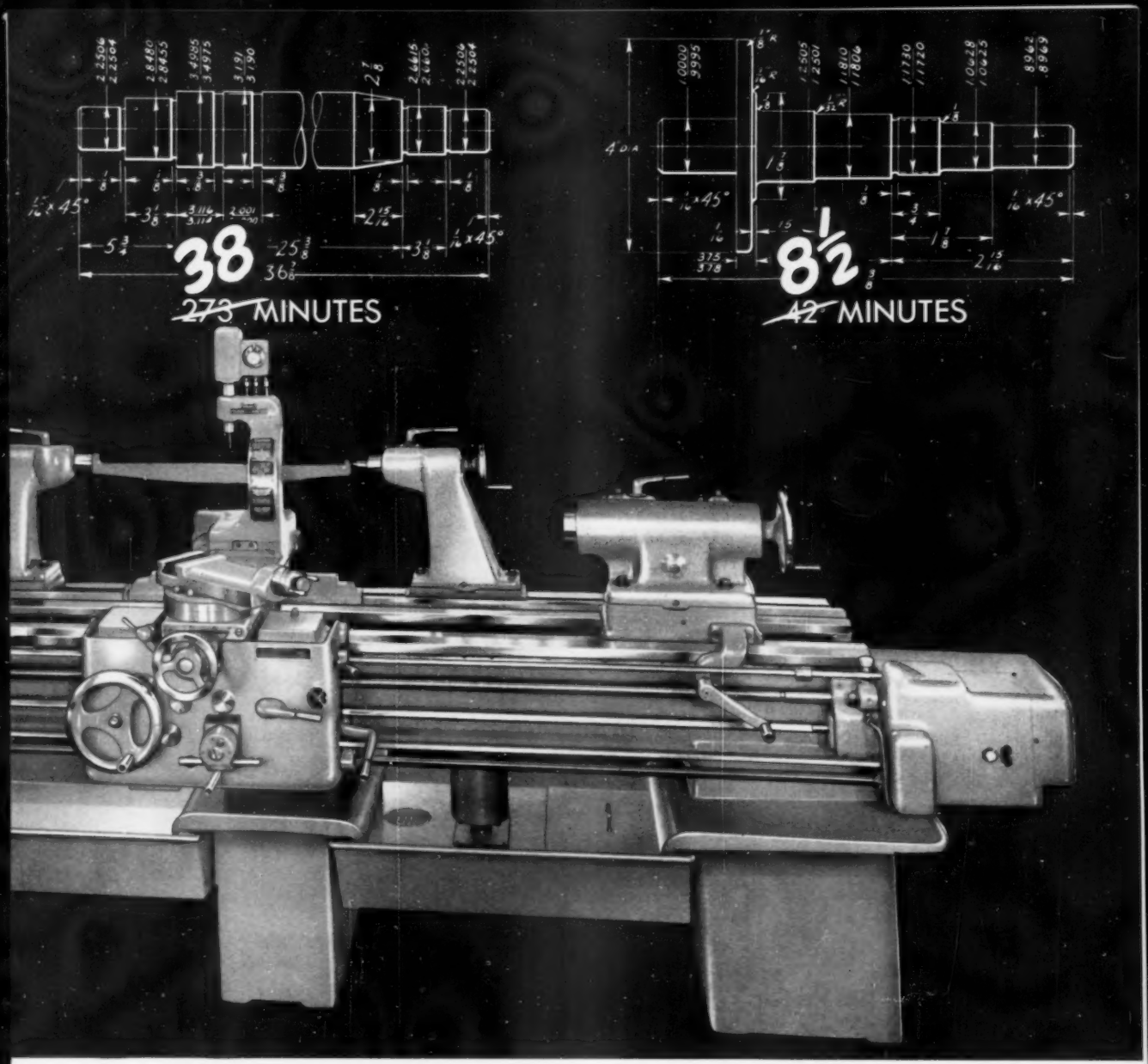
AUTOMATED

You can do both faster, more accurately, on Sidney fluid-tracer lathes using either templates or masters.

Why? Here are some of the reasons:

- **Rugged high-sensitivity tracer head.**
- **Real machine rigidity with exclusive double wall bed.**
- **Exclusive constant mesh herringbone gears throughout the head.**

And remember — Sidney tracer lathes are switched to standard operations in just a few seconds.



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...of short run or production parts

Ask for "Fluid Tracer" Bulletin

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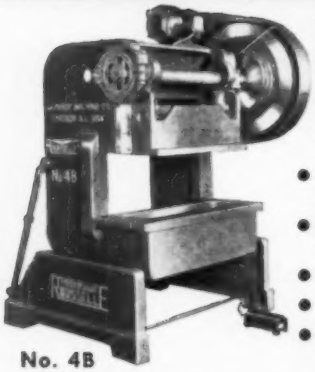
SIDNEY, OHIO
Wholly owned subsidiary of Buhr Machine Tool Co.

SIDNEY

New 40-TON DOUBLE CRANK O.B.I. ROUSSELLE



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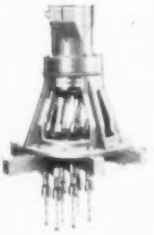

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Special Fixed Center Drillhead . . . Made to your requirements. Full Ball Bearing Construction.

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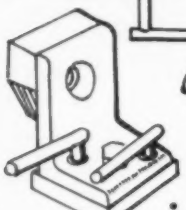

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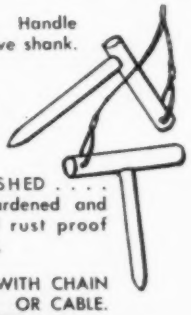

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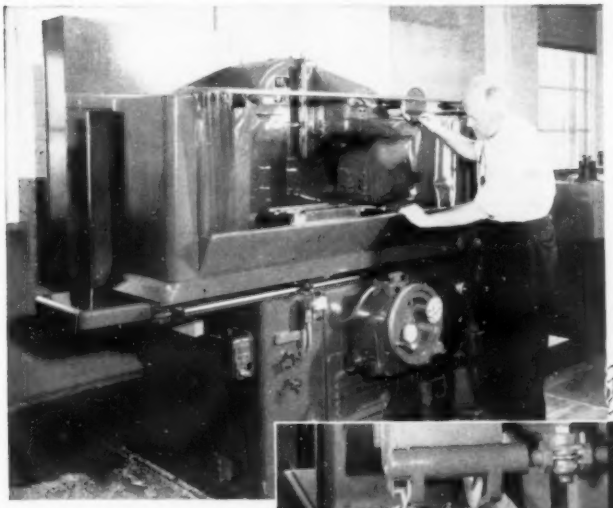

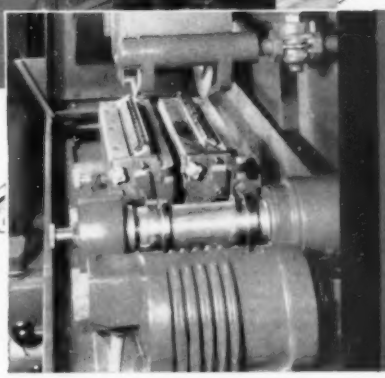

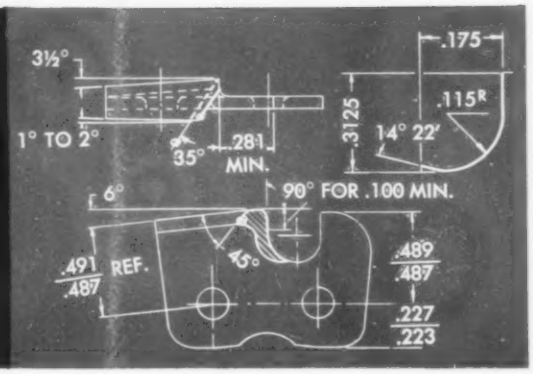

For 140 years, the policy of The Draper Corporation of Hopedale, Mass., has been to offer the highest quality product at the least possible cost.

Following this policy, its subsidiary, BlueJet Corporation, manufacturers of the famous BlueJet saw chain, installed a Thompson Truforming grinder to grind the cutting edges on their chain saw routers. These routers were formerly ground, piece by piece, by a force of 8 employees.

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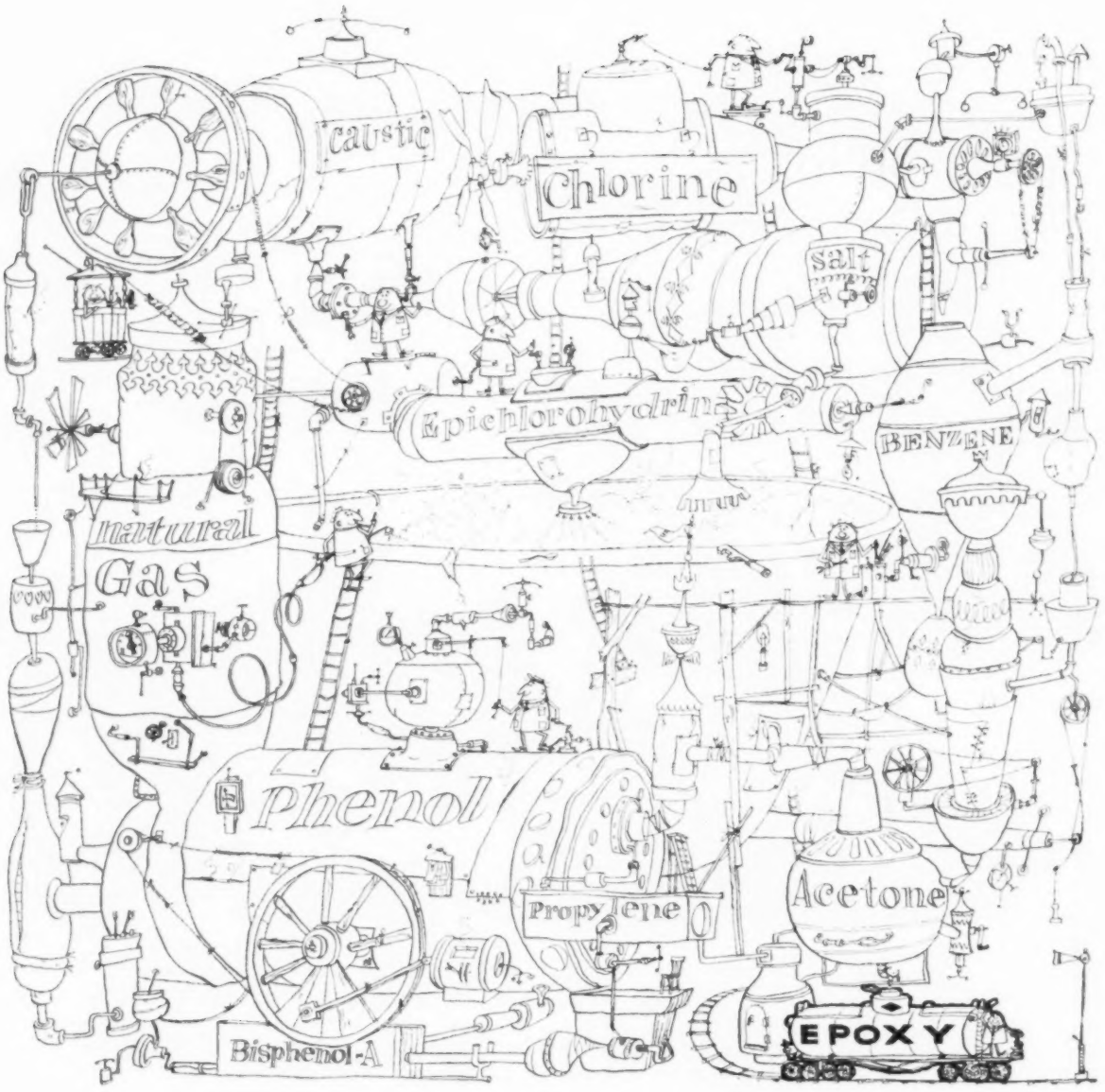

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Purity is only one benefit enjoyed by users of Dow epoxies. Others are: better quality control, narrower range of specifications, an assured source of supply, and versatility of raw materials. The exclusive control of ingredients has resulted in new and improved epoxies such as D.E.R. 332 (new water-clear liquid resin) and Dow's new line of water-white solid epoxy resins.

With years of experience in producing epoxy raw materials, Dow can assure you Dow Epoxy Resins will best meet your highest specification standards. For information or copies of this cartoon contact your Dow sales office. Or write: THE DOW CHEMICAL COMPANY, Midland, Michigan, Coatings Sales Department 2260-M1.

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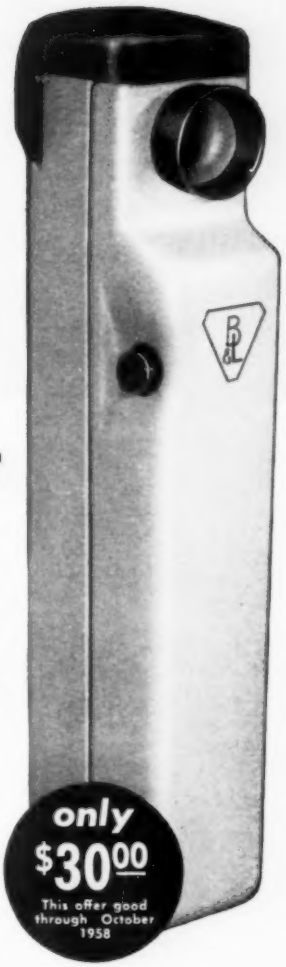

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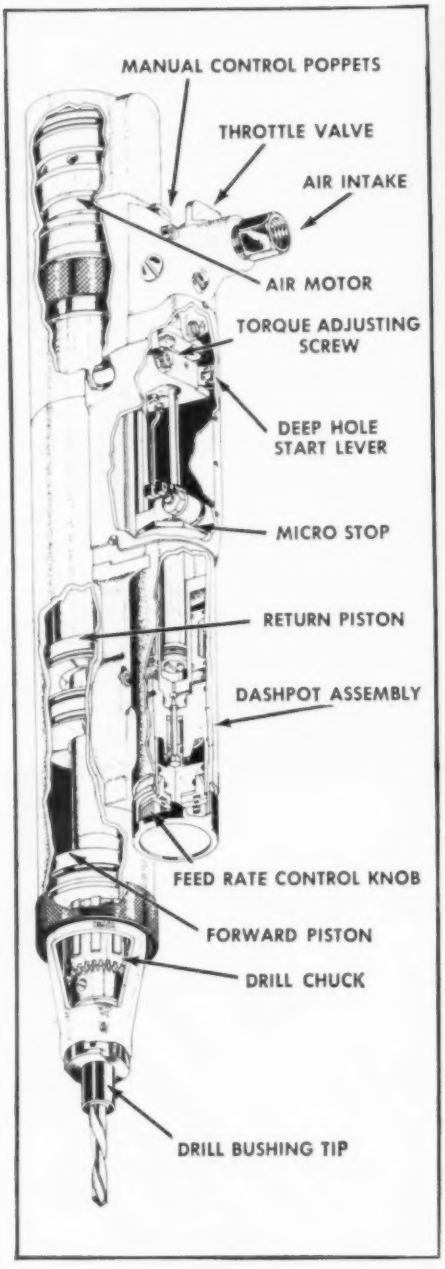
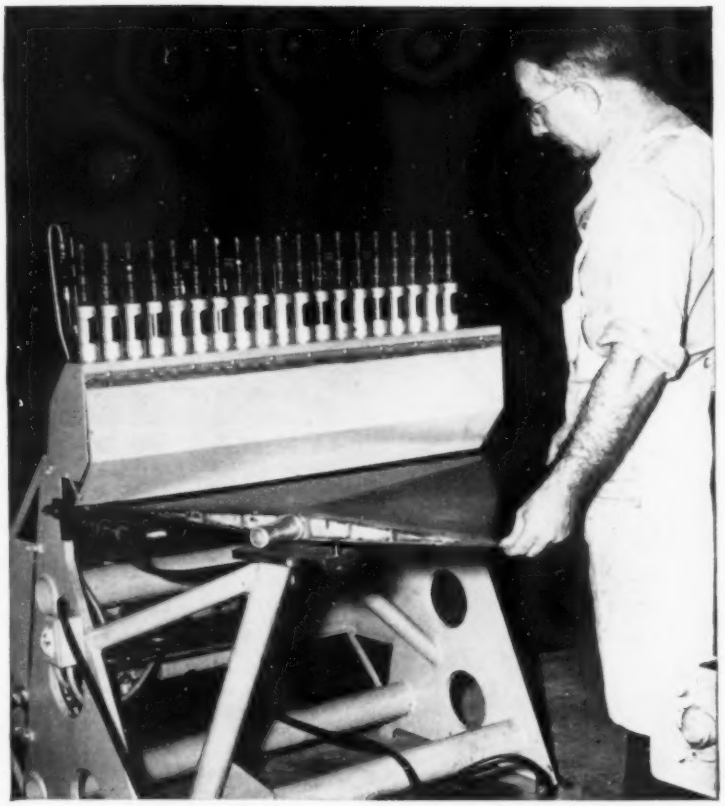
Why versatile "Airfeedrills"® cut production drilling time and costs





Adjustable stroke length—from 0 to maximum length for each size tool. Adjustable backstop varies length of return stroke . . . stops it at point where drill clears work . . . positions it to drill next piece immediately.

Adjustable, variable feed—controlled to the proper rate for drilling various materials by means of a self-contained dashpot. Rapid return is achieved through by-passing the feed-rate adjusting mechanism.

Self-supporting—"Airfeedrills" can be mounted in any position or odd angle. Tool is mounted to fixture that is secured to workpiece. No tool wobble or misalignment. Holes are accurate because drill bushing guides the drill bit.

Versatile in use—mount "Airfeedrills" as a unit for automatic drilling . . . use one as a stationary drill mounted on an inexpensive fixture . . . or as a portable drill, the "Airfeedrill" hangs by its nose for precision drilling.

Versatile in operation—cut time and costs in drilling, reaming, countersinking, chamfering, counterboring or spot-facing.

For complete information, see your Gardner-Denver representative or request Bulletin 92.

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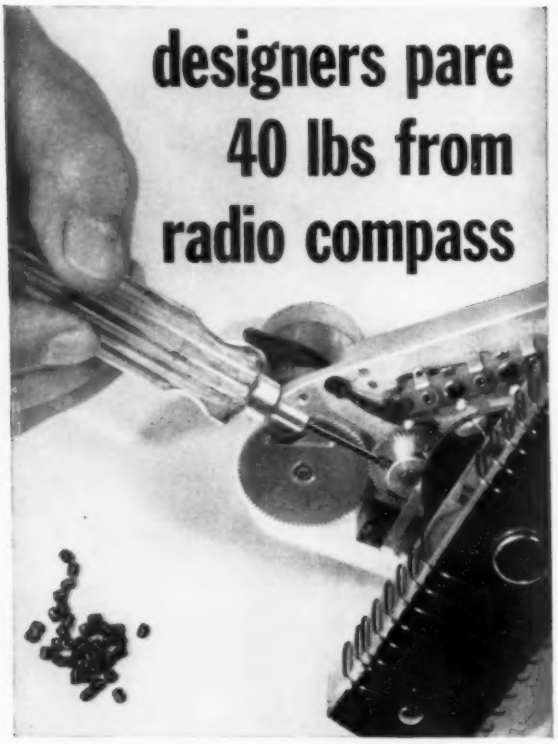

. . . but stick to Bristol socket screws

Engineers at Aircraft Radio Corporation, Boonton, N. J., have done an outstanding job of miniaturization in their new ARC Type 21 Automatic Direction Finder—reducing bulk 60% and weight to only 19.1 lbs—as against 60-100 lbs for older models, with no sacrifice in performance.

Like many other ARC navigation and communication aids for aircraft, the new direction finder uses Bristol Multiple-Spline socket set screws in many places such as the antenna shown above during assembly. ARC engineers particularly like these Multiple-Spline features:

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2. Performance reliability—a vital factor in ARC's equipment. Bristol Multiple-Spline set screws hold fast under shock and vibration because they can be wrenched up tighter.

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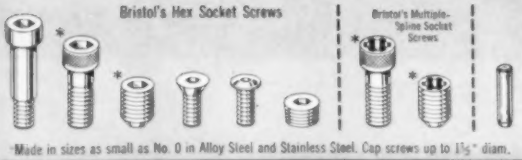
A.B.2

Precision socket screw manufacturers since 1913



*Made in sizes as small as No. 0 in Alloy Steel and Stainless Steel. Cap screws up to 1½" diam.

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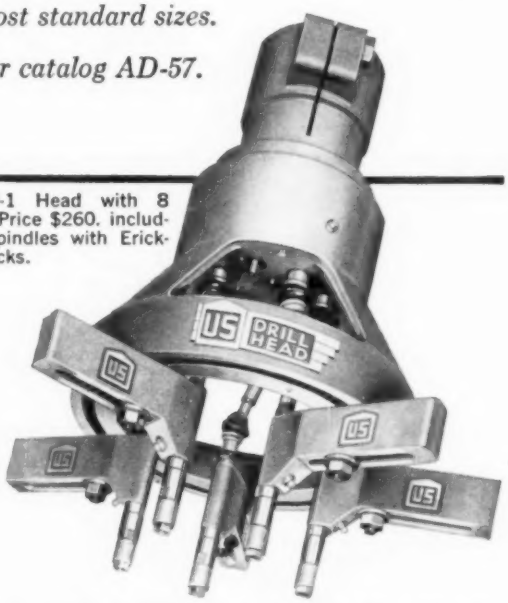
U-1L	8	¼"	8"
U-1½	6	½" or ¾"	6"
U-2	10 or 12	½" ¾"	10" 9¾"
U-3	10 or 12	15/32" to ⅞"	12"
U-4	12	15/32" to 1-1/16"	15"



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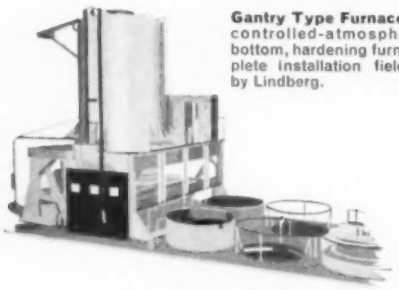
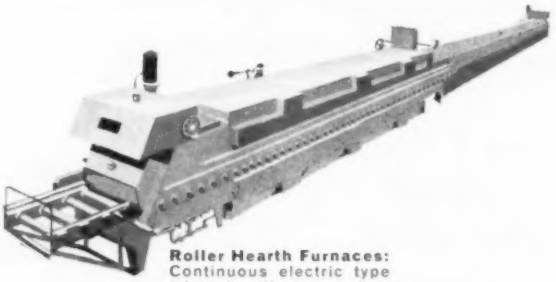
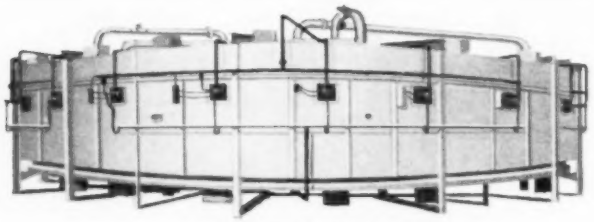


Gantry Type Furnace: Vertical, controlled-atmosphere, drop bottom, hardening furnace. Complete installation field-installed by Lindberg.



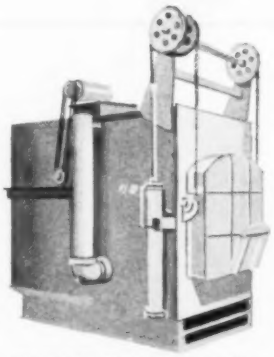
Roller Hearth Furnaces: Continuous electric type (shown) with temperature range 1300° to 2100° F.



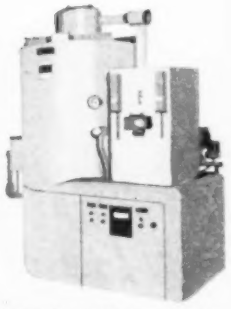
Rotary Hearth Furnaces: Doughnut type field-installed gas-fired furnace (shown) with capacity of 13,000 lbs. per hour.

HF Induction Heating Units: Available in 5, 10, 25 and 50 KW units.

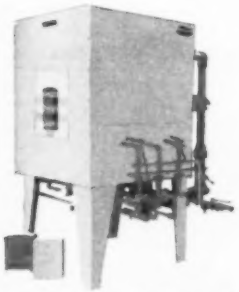
Vertical Type Furnaces: Carburizing and hardening furnace (shown) with CORRTHERM electrical heating elements.



Super-Cyclone Tempering Furnace: Production box type. Electric or gas. Two temperature ranges—to 1750° F.



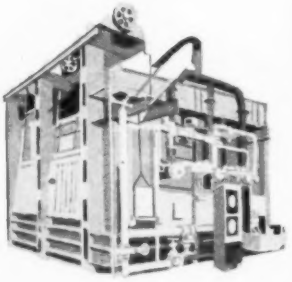
Atmosphere Generators: Hyen generator (shown) for endothermic atmospheres. Generators for all required atmospheres.



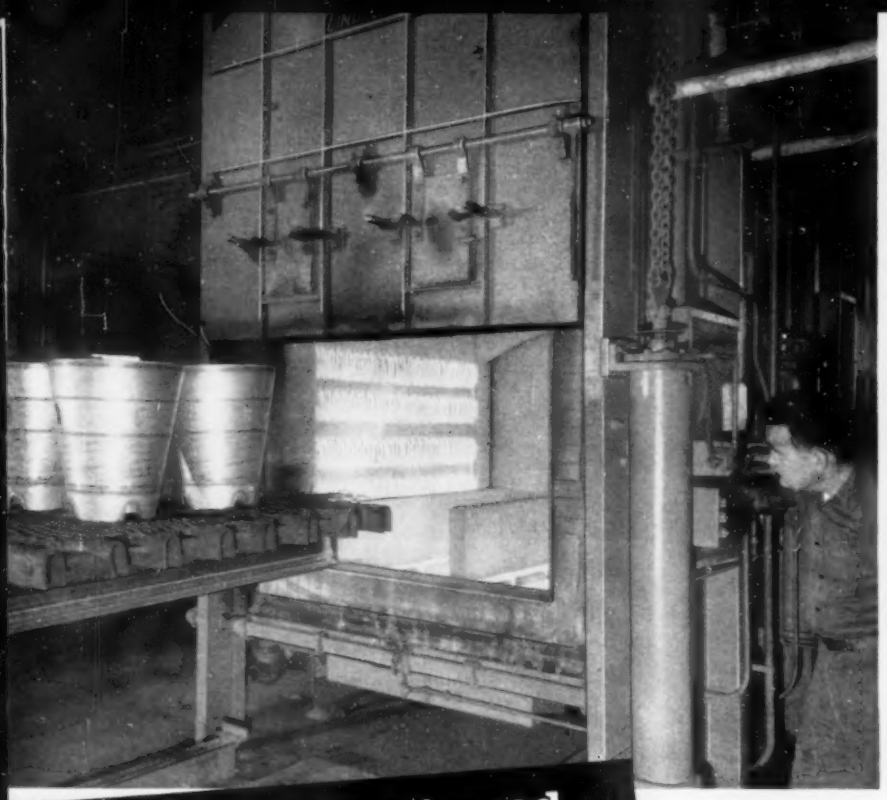
Ceramic Kilns: Gas-fired periodic kiln (shown) with temperature range to 3250° F.

Melting and Holding Furnaces: Electric resistance furnace (shown) with capacities of 750 lbs. to 1500 lbs.

Laboratory Equipment: One-unit box furnace (shown), muffle or for non-oxidizing atmosphere with temperature range to 3000° F.



Aluminum Reverberatory Furnaces: Twin-chamber melting and holding furnace (shown) with 45,000 lbs. capacity.



Lindberg-Designed

heat treating installation reduces jet engine parts pickling costs 25% for Jervis

This specially designed annealing and heat treating furnace at Jervis Corporation, Grandville, Michigan, is an interesting example of how cooperation between the user and the maker of heat treating equipment can adopt established furnace principles to the improvement of production methods. Jervis and Lindberg engineers, starting with a conventional box type furnace, designed this furnace with two chambers, one for preheat and one for high heat, and added a third with a water jacket for protective cooling. This combination provides efficient heat equalization, protective atmosphere, and protects against corrosion and carbide precipitation. Jervis estimates this furnace provides a 25% reduction in pickling costs, as well as improved quality, in the treating of jet engine parts.

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The handsome Jervis plant at Grandville, Michigan occupies 238,300 square feet of floor space.

Mr. James Bockheim, Metallurgist at Jervis, says, "We can handle any aircraft material in this furnace . . . and operate it with just one man."

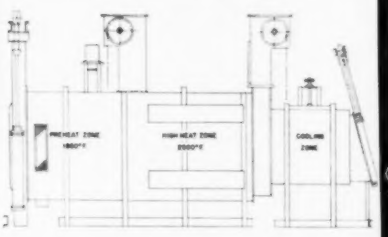
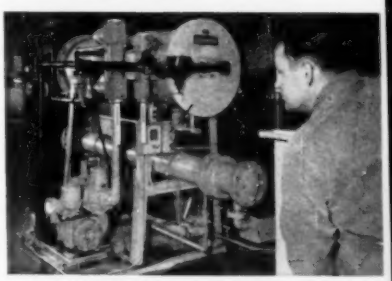


Diagram shows the unusual three-chamber furnace design.

Work coming from the cooling chamber after treatment.



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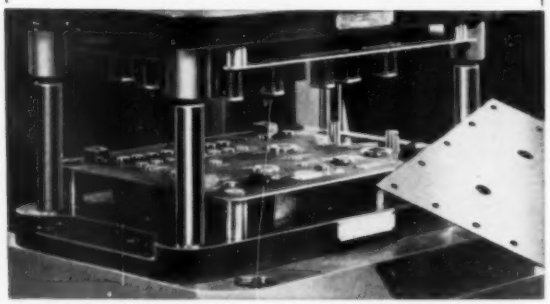

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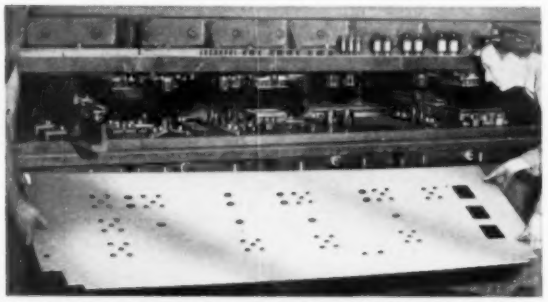

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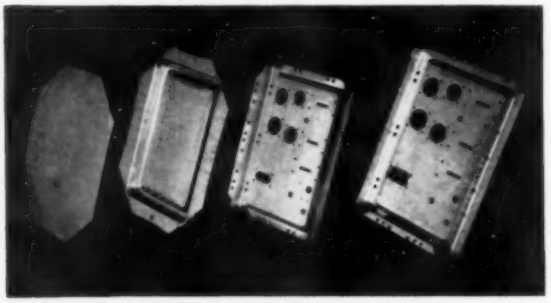

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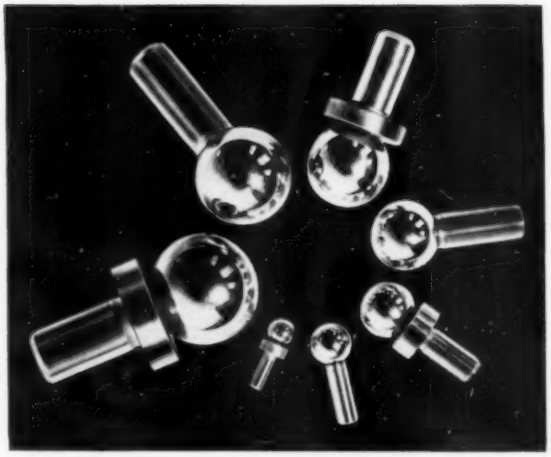

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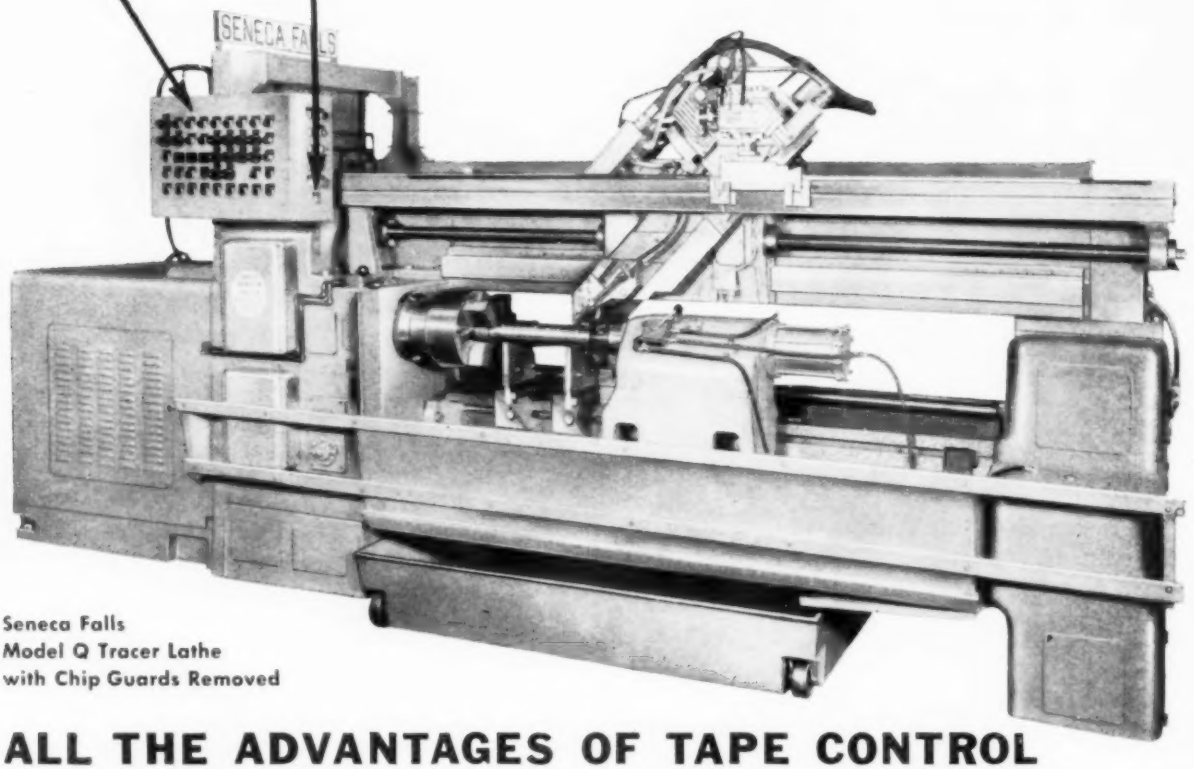

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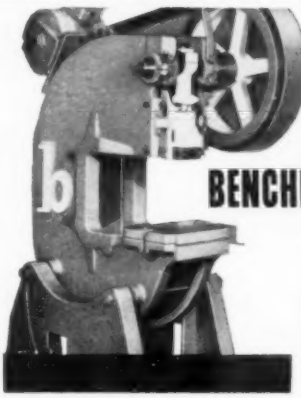

MEASURE THIS BENCHMASTER THROAT

...the small press that does BIG press jobs!

There's no matching Benchmaster variety and versatility. For example, Benchmaster makes *17 different press models with many variations of each* . . . in stroke length, shut height and throat depth.

This 8 ton **BENCHMASTER DEEP THROAT PRESS** is typical of Benchmaster strength and ruggedness. *It punches to the center of a 24" circle,* comes in a choice of 3 shut heights: 9", 12" or 15" exclusive of bolster plate. Stroke lengths to 3".

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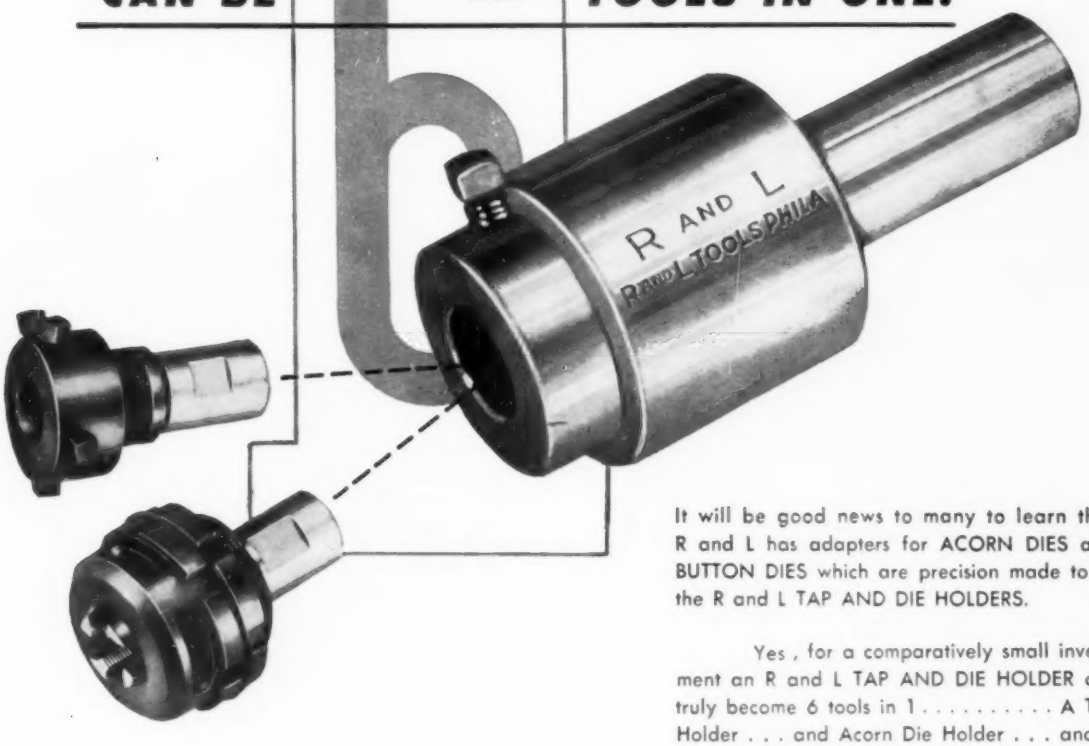
THE RIGHT R and L LEFT TAP AND DIE HOLDER

CAN BE 6 TOOLS IN ONE!



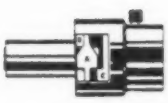


Figure 1.
Ready to start threading operation, clutch slightly engaged at C.

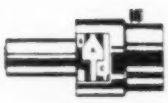


Figure 2.
Instantly engaged to full contact between A and C as soon as tap or die engages work.

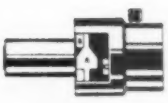


Figure 3
Fully released showing ample clearance between contact points of clutch preventing re-engagement or hammering of clutch points in case turret advances slightly after clutch releases.

• By substituting a shorter clutch ring retaining nut this tool can be readily changed for cutting extra short threads.

It will be good news to many to learn that R and L has adapters for ACORN DIES and BUTTON DIES which are precision made to fit the R and L TAP AND DIE HOLDERS.

Yes, for a comparatively small investment an R and L TAP AND DIE HOLDER can truly become 6 tools in 1 . . . . . A Tap Holder . . . and Acorn Die Holder . . . and a Button Die Holder . . . *For right and left hand threading* and tapping.

LEST YOU FORGET . . .
. . . The R and L TAP AND DIE HOLDER has an entirely new releasing mechanism, and can readily be changed for right or left hand threading and tapping. No spring plungers to wear or break. No small screws to work loose.

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R and L TOOLS TE-10
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☐ Please send me your new catalog
☐ Please arrange for no-obligation demonstration of R and L TOOLS

NAME .....
COMPANY .....
ADDRESS .....
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RIGHT R and L LEFT **TOOLS**
1825 BRISTOL STREET • PHILADELPHIA 40, PA.

OTHER FAMOUS R and L TOOLS:

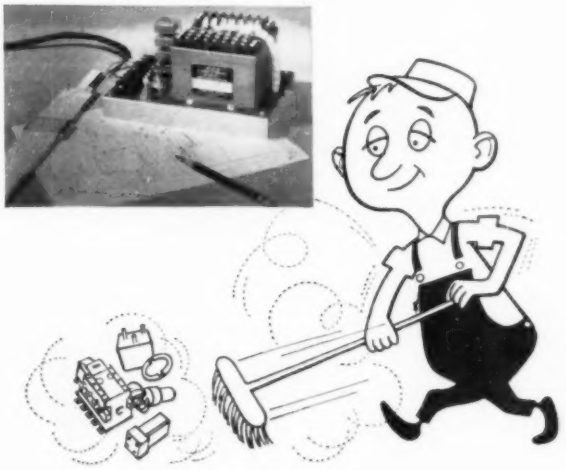
TURNING TOOL • COMBINATION SWING TOOL • CARBIDE OR ROLLER BACKRESTS RELEASING OR NON-RELEASING TAP AND DIE HOLDERS, (ALSO FURNISHED FOR ACORN DIES) • UNIVERSAL TOOL POST • CUT-OFF BLADE HOLDER • RECESSING TOOL REVOLVING STOCK STOP • FLOATING DRILL HOLDER • KNURLING TOOL

JOURNAL OF APPLIED CONTROL DEVICES THAT NEVER WEAR OUT

For Control Engineers Who Are Wearing Out Before Their Time

HIGH SPEED STATIC SWITCHING *(at half the price)!*

Sylvania Electric Products Co. engineers have just replaced an electronic relay, two small mechanical relays, a limit switch, and a separate power supply with a single CONTROL switching reactor which costs only half as much! They did it by taking advantage of the multiple windings on a CONTROL switching reactor—equipment which, because of its static operation, never wears out. Seems a high speed assembly operation on one of Sylvania's complex, highly automated vacuum tube production machines calls for a magnetic clutch to drive an index table. The clutch orients the work part by rotating it until current flows through two properly located contacts. Our CONTROL switching reactors not only cut costs in half, but do a job that the relays couldn't do: provide the ultra high speed signal necessary for proper switching in the automated assembly. *It worked so well Sylvania said, "I'll be switched!" We said, "With a 10,000 to one switching ratio, and ratings of 15, 75, 150 and 300 VA, most anything for control can be!"*

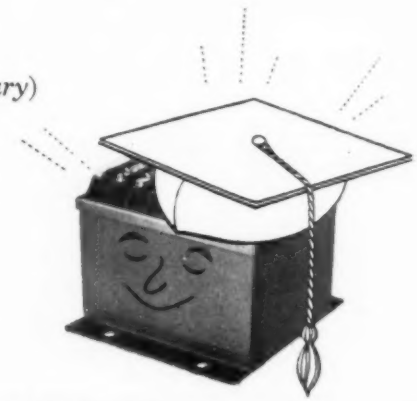


ONCE UPON A TIME . . . *(time delay, that is)*

Versatile, we are too! The same type of CONTROL switching reactors that work so well for this high speed switching also are used by Sylvania engineers to eliminate production breakdowns caused by relay failures in time delay circuits. Many pneumatic time delay relays on their production machines were dying young (three months of age or less). CONTROL switching reactors (which, naturally, never wear out) not only have no moving parts, but do a dandy job with time delay relaying, easily handling 6,000 closures per hour. Sylvania happily expects its CONTROL reactors to last twenty years. *"Right now," Sylvania says, "we're not too worried about what will happen after that." Need you be any more worried than they?*

LOGIC, MY DEAR WATSON *(. . . is elementary)*

Our educated switching reactors are masters at logic—the kind that gets built into automatic control operations. AND, OR, NOT, MEMORY and TIME DELAY—all are built into these high IQ reactors. By employing several isolated control windings, one reactor can translate many inputs (from push buttons, limit switches or other reactors, for instance) to any logic needed to switch very appreciable loads. And are they easy to use! Order standard units right from the catalog. You need no high falutin' systems engineering or auxiliary hardware (single purpose logic units, preamplifiers or transformers). *No wonder logical people order our logic-providing switching reactors. Can we send complete details to you?*



Reliability begins with CONTROL

A DIVISION OF MAGNETICS, INC.

Dept. T-54, BUTLER, PENNSYLVANIA

Profit by UDDEHOLM'S Complete Service In Precision Ground Tool Steel

Two new Uddeholm features—features that continue their benefits *after* delivery—now add further convenience to your use of Precision Ground Tool Steel.

Rust-Preventive Envelopes Each piece of Uddeholm Ground Flat Stock is now wrapped individually in corrosion-inhibiting VPI paper. You can use these envelopes to store degreased steel indefinitely without danger of rust.

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And don't overlook these other important reasons why Uddeholm continues to be your most reliable source for Precision Ground Tool Steel: A tremendous selection of available sizes to meet your needs more closely—Choice of oil-hardening UHB-46 (SAE O1) or air-hardening UHB-151 (SAE A2)—A world-wide reputation of tool steel quality, guaranteeing you the finest performance possible—Ample warehouse stocks and fast service to get your *complete* order to you without delay.

Write for this handy, 8½" x 11" stock size chart of Uddeholm Precision Ground Tool Steels

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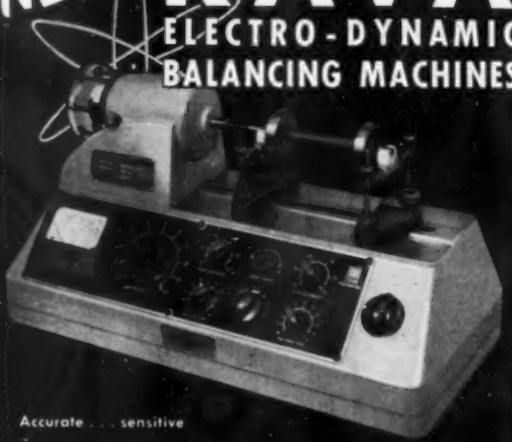
ELECTRO-DYNAMIC BALANCING MACHINES



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VAILL
TUBE END-FORMING MACHINES
shape and form tube ends
fast... accurate... at less cost

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Save time on production and non-production jobs. KDK Tool Holder and Bars give unlimited operations on set-up. 5 bars will hold 9 tools with 24 combinations that can do most any job and save hours of set-up time. KDK permits quick change of bars, increasing production as high as 400% over other type holders.

- **REDUCES SET-UP TIME AND INCREASES MACHINE TIME**
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FOR THREADED INSERT DRIVING
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Stud Setting and Pulling

Automatic Self-Opening Stud Driver — 100 Series Featuring Collapsible Type Trip Gage!

Automatic take-up for wear on jaws. Affords accurate maintenance of projection heights. Inexpensive method of clutch renewal gives double wear at half the cost.

"Extracto" Stud Remover for Aircraft Engines

Small tool nose diameter for use in close quarters. Permits re-use of studs by gripping thread on nut end of stud—will not mar threads. Made in standard sizes for #10 to 5/8" studs.

"Bull Dog" Stud Driver Designed for Use With Impact Wrenches

Built for rugged use on heavy engines. Equipped with Titan Design, Loose Pressure Plunger. Definitely stands up under vibration encountered when using an impact wrench for motive power.

Titan "Roll Grip" Combination Stud Driver and Puller

Incorporates roll action to grip as little as 1/2 in. of unthreaded body of stud. Made in standard sizes from 3/16 to 3 in. inclusive.

TITAN TOOLS

World's Largest Producers Of Stud Drivers And Pullers

TITAN TOOL CO.

44 MAIN ST., FAIRVIEW (ERIE COUNTY), PA.

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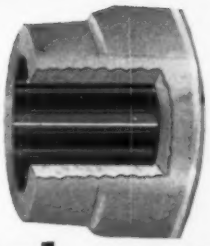
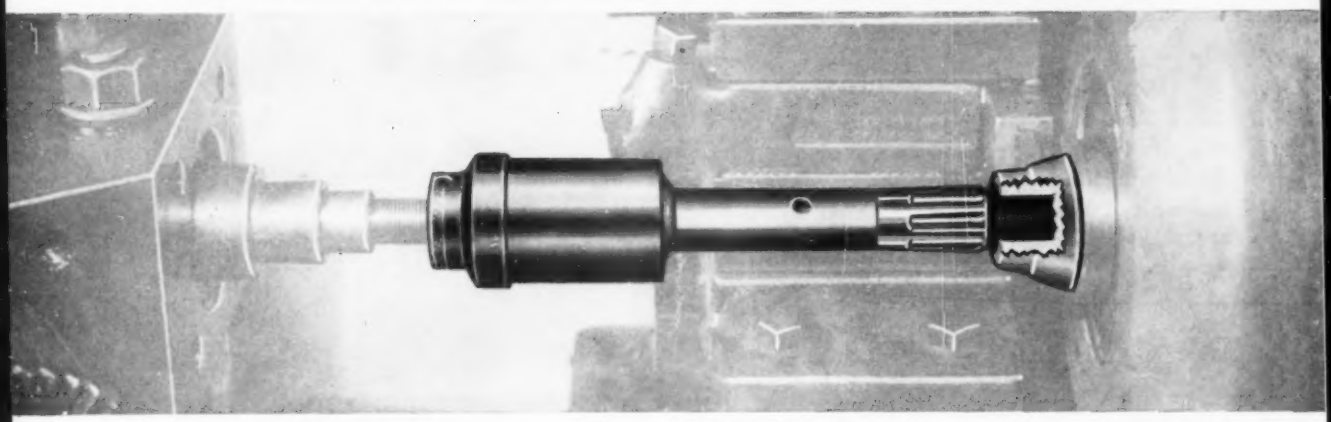
from 125 to 5 micro-inches  *surface finish*

in one 5-second pass!



with the revolutionary Microller burnishing tool

- Finishes roughest bored or turned surfaces (ie: 200 mu-in. and higher) to finishes of 4 micro inches and lower.
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- Finishes all machineable metals . . . all types of surfaces; internal and external cylindrical . . . tapered, radial, flat.

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- The top twenty companies in the metal working field . . . plus more than a thousand others have replaced costly finishing and sizing methods with the Microller burnishing tool. In actual case histories, finishing costs have been cut by 90% . . . production rates increased by eight and nine times.
- *Results guaranteed:* The Microller is backed by Madison-Faessler's 80 years of experience in producing cold rolling tools . . . and is sold on a results guaranteed basis. Sales and service representatives in all principal cities.
- *See our demonstrations at Booth No. 1224 at the Tool Show . . . or write for further information.*

(Affiliated with Madison Industries)

MADISON-FAESSLER TOOL CO.
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use tool in any machine!

No special equipment needed. Use the Microller in any of your present machines . . . on a drill press, engine or turret lathe as a secondary operation . . . or right on the screw machine or automatic where the other operations are performed!

AVERAGE TOOL COSTS LESS THAN $190.00

SHOW THIS TO YOUR TOOLMAKER

Ask him if he doesn't agree that the Leland-Gifford No. 2LMS Toolroom Drill Press provides every feature and convenience needed in the modern toolroom for fast, accurate, effortless drilling and tapping. Developed in cooperation with leading tool engineers, this machine has won wide acceptance as the ideal drill press for general purpose toolroom use. Write for complete information.

LELAND-GIFFORD
No. 2LMS
TOOLROOM DRILL PRESS
with all these features:

1 Illuminated indicating shift with cutting speed chart.
2 Conveniently located hand wheel for changing spindle speeds without stopping machine . . . also for shifting back gears when furnished.
3 Positive stop for accurate depth adjustment.
4 Capacity of No. 2 Morse taper. No. 3 MT optional.
5 Extra large 37″ x 25″ or standard 26″ x 25″ work table.
6 26″ swing with 13″ overhang.
7 Handy push-back table raising crank and quick-acting table lock.
8 Foot switch start-stop motor control leaves operator's hand free.
9 Counterbalanced sliding head for effortless vertical adjustment.
10 Built-in light for table and work surface illumination.
11 Sensitive hand lever feed with ratchet adjustment, or . . .
12 Reversing motor control for tapping — provides manual control from feed lever or automatic control by depth stop (optional at small extra charge).

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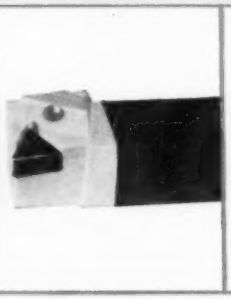
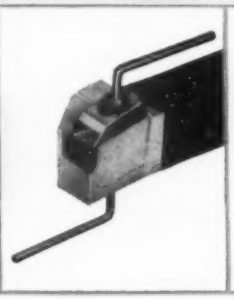
ADAMAS DEX-A-TOOL cuts machining costs

Only Dex-A-Tool gives you all 10 modern design features . . . features that mean faster set-up, closer tolerances, fewer parts, and less downtime.

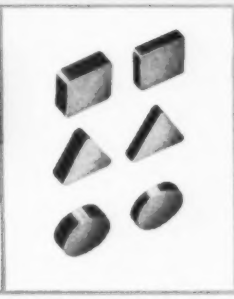
Fully adjustable chipbreaker . . . in increments of .030". Insures excellent chip control. One piece positive locking. No wasted machine time changing non-adjustable chipbreakers to get proper chip control.



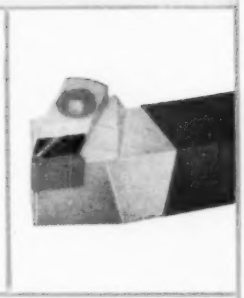
Extra thick carbide anvils . . . thickest shank-supported anvils in the industry. The thick anvil in Dex-A-Tool gives more rigidity to throwaways and provides the ideal platform for maximum insert performance.



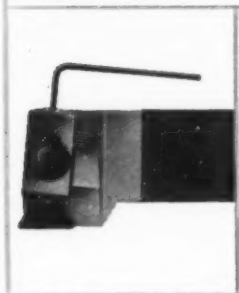
Easy indexing . . . clamp locking screw may be loosened from bottom as well as top. Simplifies insert indexing when holder is upside down.



Holds both "thick" and "thin" inserts . . . allows you to utilize economical thin inserts (1/8") wherever possible and still maintain the advantage of switching to thick inserts (3/16") whenever necessary.

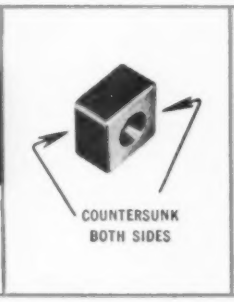


Chipbreaker Clamp Faced with Thick Carbide . . . provides much more wear resistance than thin carbide coating or cast alloy clamp.

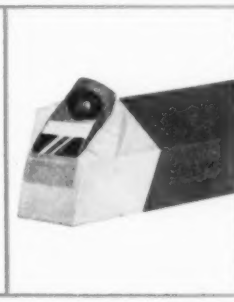


Setscrew chipbreaker clamp . . . permits fast positive resetting of chipbreaker after insert indexing. Nylon plug engages the setscrew and prevents any loosening of setscrew.

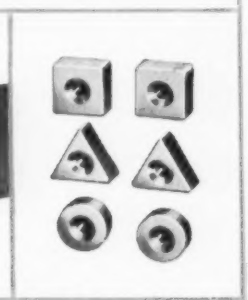
Combination chipbreaker—clamp . . . single unit construction means no loose chipbreakers to fall out. Inventories reduced. Simpler use gives a savings in production time.



Anvil invertible as well as indexable . . . extra thickness of anvil allows countersinking of both sides. This permits anvil to be inverted for extra life.



Special high temperature brazing alloy . . . used in brazing carbide chipbreaker to clamp. Prevents braze failure during high machining temperatures.



Carbide or steel anvils . . . your choice of carbide or copper plated hardened high speed steel anvils.

No other toolholder has fewer parts than Adamas Dex-A-Tool . . . none are easier to operate. Dex-A-Tool's features add up to more production per insert corner. Measure this extra savings on your own machines . . . plan a test of Adamas Dex-A-Tool today!

For additional Dex-A-Tool literature, an actual demonstration test, or a free copy of "Throwaway Tooling Set-up and Follow Thru" write: Dept. 263

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CARBIDE CORPORATION, KENILWORTH, N. J.

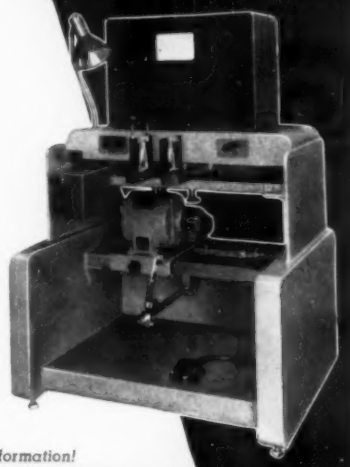
PRODUCERS OF TUNGSTEN CARBIDE TOOLS, TOOL TIPS, DIES, WEAR PARTS, DEX-A-TOOL AND CERALOX.

Team Dex-A-Tool with Adamas throwaway inserts and gain top performance under varying machining conditions . . . top performance possible only through Adamas wide range of quality controlled grades.

BEKD

BALANCING MACHINES

- Automatic Indications
- Single Knob Control
- Superior Accuracy
- Dependable Quality
- 14 Dynamic and Static Models



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BALANCE ENGINEERING COMPANY

5042 West Lake Street • Chicago 44, Illinois

Telephone: COlumbus 1-5035

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NO NEED FOR EXACT ALIGNMENT!

Types to fit any machine used for tapping or reaming.

When making set-ups for tapping and reaming jobs, the work need not be aligned with the spindle to a high degree of exactness if you use a Ziegler Floating Tool Holder rather than an ordinary tool holder. The reason is that the Ziegler automatically compensates for inaccuracies in alignment even though they may amount to as much as 1/16" (on the diameter).

The Ziegler Holder always floats freely, without friction or cramping, even under the severest tool-driving strains, taking any and all end-thrusts. Try it and see how much superior it is to any holder that you have ever used.

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roller drive floating tool-holders

13566 Auburn • Detroit 23, Michigan

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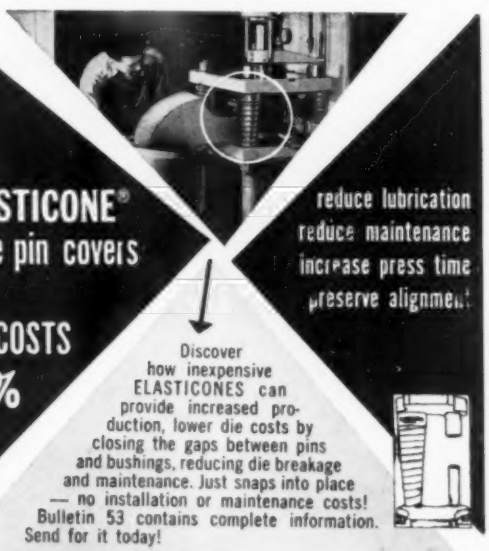

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reduce lubrication
reduce maintenance
increase press time
preserve alignment

Discover how inexpensive ELASTICONES can provide increased production, lower die costs by closing the gaps between pins and bushings, reducing die breakage and maintenance. Just snaps into place — no installation or maintenance costs! Bulletin 53 contains complete information. Send for it today!

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TO OBTAIN FURTHER INFORMATION ABOUT ADVERTISERS, TRADE LITERATURE OR TOOLS OF TODAY APPEARING IN THIS ISSUE OF THE TOOL ENGINEER, USE THE HANDY READERS SERVICE CARD ON PAGE 167.

LEADERSHIP at work

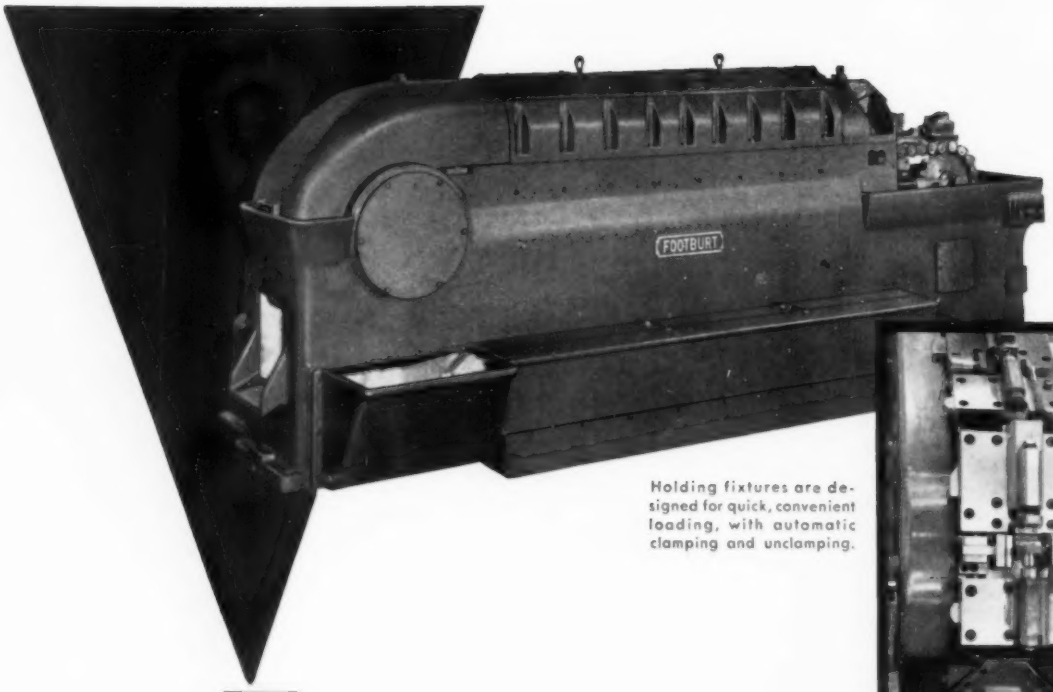
Many heads are better than one— They use six Kearney & Trecker Rotary Head mills to slash tool, die, and mold-making costs at Triangle Tool Co., Los Nietos, Calif. Here these Kearney & Trecker— Milwaukee Model D, Rotary Head mills employ the unique rotary head method of milling to produce intricate shapes *direct* from blueprint designs into metal in only one setup! That's how Triangle eliminates jigs, fixtures, models and templates— saves on material, time and labor.

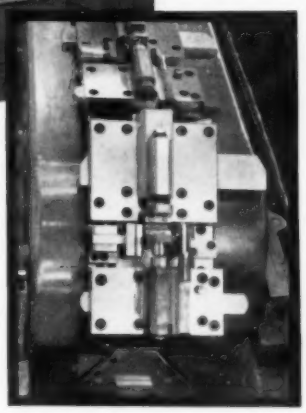
6772 West National Avenue
Milwaukee 14, Wisconsin

KEARNEY & TRECKER
MILWAUKEE

Kearney & Trecker's man on the job . . .
Verne Kidwell of Moore Machinery Co., Los Angeles, assisted Triangle in planning Model D installations. *For expert milling counsel, call the K&T man near you. And remember to ask him, or write direct, for free, comprehensive catalog.*

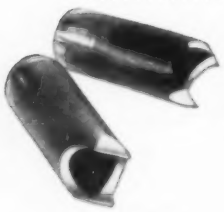
Kearney & Trecker staff photo by Ron Johnson





Holding fixtures are designed for quick, convenient loading, with automatic clamping and unclamping.

LOWER COST . . . PER PIECE WITH SURFACE BROACHING OF SMALL PARTS



In many plants where large quantities of duplicate metal parts are being machined, substantial savings are being made through the adoption of surface broaching. Production is exceptionally high, close tolerances are maintained, and tool maintenance costs are much lower than with ordinary methods. Foote-Burt engineers, pioneers in this advanced machining method, have had a wide experience in applying surface broaching, in many fields.

THE FOOTE-BURT COMPANY
Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

ENGINEERED FOR PRODUCTION

Write for Circular No. 503

FOOTBURT

PIONEERS IN SURFACE BROACHING

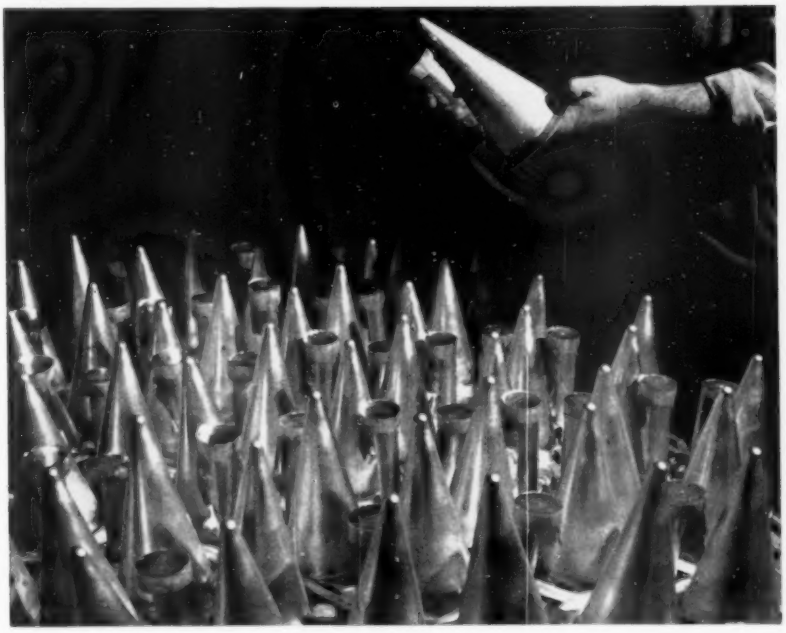
Tool Steel Topics

BETHLEHEM STEEL

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributors: Bethlehem Steel Export Corporation



Wind shields for 120-mm shells die-cast with Cromo-High V tool steel

Each piece has to be virtually perfect when you're die-casting aluminum wind shields for 120-mm shells. Tooling up for a job like this calls for a hot-work steel that will turn out high-quality castings and at the same time keep production costs low.

Bethlehem has several grades of hot-work tool steel which could be considered for such a highly specialized application.

The die caster weighed all the facts with Bethlehem's local tool steel distributor. Together, they came up with an excellent tool steel for jobs of this sort—Cromo-High V.

Cromo-High V is our 5 pct chromemoly hot-work tool steel, containing 1 pct vanadium. A grade that has proved its stubborn resistance to wash and erosion, it also has the stamina for long runs.

Cromo-High V is uniformly annealed for easy machining. It has good center density and grain refinement, and is free from porosity. And there's little chance of cleavage cracking when adequate radii are used in the die, and the steel is properly heat treated.

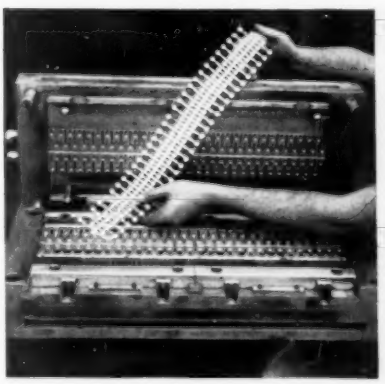
A trial run with Cromo-High V is the best way to learn how good a tool steel it really is. Your local Bethlehem tool steel distributor either has it in stock, or can get it delivered to you quickly.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Air-quenching means longer service life for hot-work tools

Most hot-work tool steels can be hardened by quenching in oil or air. Because of convenience in handling, and to avoid excessive scale, it is often preferable to quench some hot-work tools in oil. However, air-quenching is considered better practice, for it produces lower residual stresses than when tools are liquid-quenched. Since heat-check failures develop from surface stresses which are produced in service, the presence of residual stresses in the tool can lead to premature failure.

Tools having low residual stresses are best suited for long service on hot-work applications. That's why air-quenching is usually best for hot-work tools.



Plastic Beads Molded with Duramold B

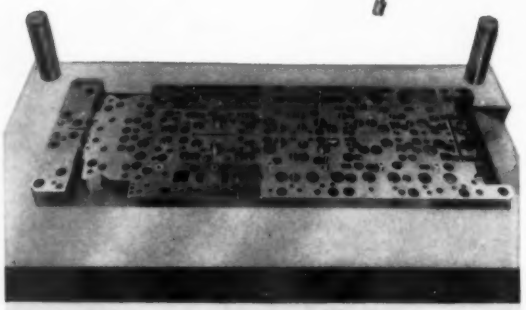
Here is an injection mold, with 120 cavities, used by R. A. Koegl Stamp & Die Works, Inc., Hillside, N. J., to produce Plastic Poppit Beads. The steel was supplied by Ackerlind Steel Co., Inc., N. Y. Duramold B is our oil-hardening chromium type of plastic-molding die steel, containing an addition of boron. Its annealed hardness of 100 max Brinell assures ease in cold-hobbing and its alloy content gives it high core strength.

H○LES

JIG GROUND with

Vulcanaire

Provide yourself with this inexpensive* instrument for use on your present equipment and JIG GRIND with a guarantee.



A seven station die from Vulcan's contract Tool Room (Your Tool Room in Dayton).

Standard sized punches and buttons were used. But since forming and piercing operations were involved, hardening of the sections was necessary followed by JIG GRINDING. Result: Close tolerances held easily and perfect progression throughout — another satisfied customer.

*Vulcanaire equipment pays for itself on the first job.

Borrow our instructive 11 minute movie on Jig Grinding.

SERVICES OF YOUR TOOL ROOM IN DAYTON
ENGINEERING • PROCESSING • BUILDING • TOOLS
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VULCAN TOOL COMPANY
751 Lorain Ave., Dayton 10, Ohio

VULCAN tools

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are your bending methods up to date?

LEARN HOW OTHERS ARE DOING IT NOW

You will see how other people use ram — rotary — roll benders in their plants. 36 pages written *in layman's language* . . . with in-plant pictures. Also letters from users.

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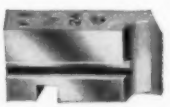
USE READER SERVICE CARD; INDICATE A-10-228-2

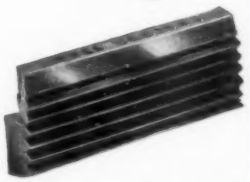
CUTTING and CHASING THREADS?

CHASO'S chasers and self opening die heads offer the fast economical way to do production threading.

CHASO manufactures all types of chasers, including tangent, circular and radial in both cut thread and ground thread for most makes of die heads.

Solid adjustable taps and chaser sharpening fixtures are also available.





Chaso Chasers are guaranteed to perform satisfactorily and at a savings in your threading costs.

Complete Line of Technical Bulletins Available

When you think of chasers think of CHASO.
MANUFACTURING CHASERS FOR 25 YEARS

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ASTE DATA SHEETS

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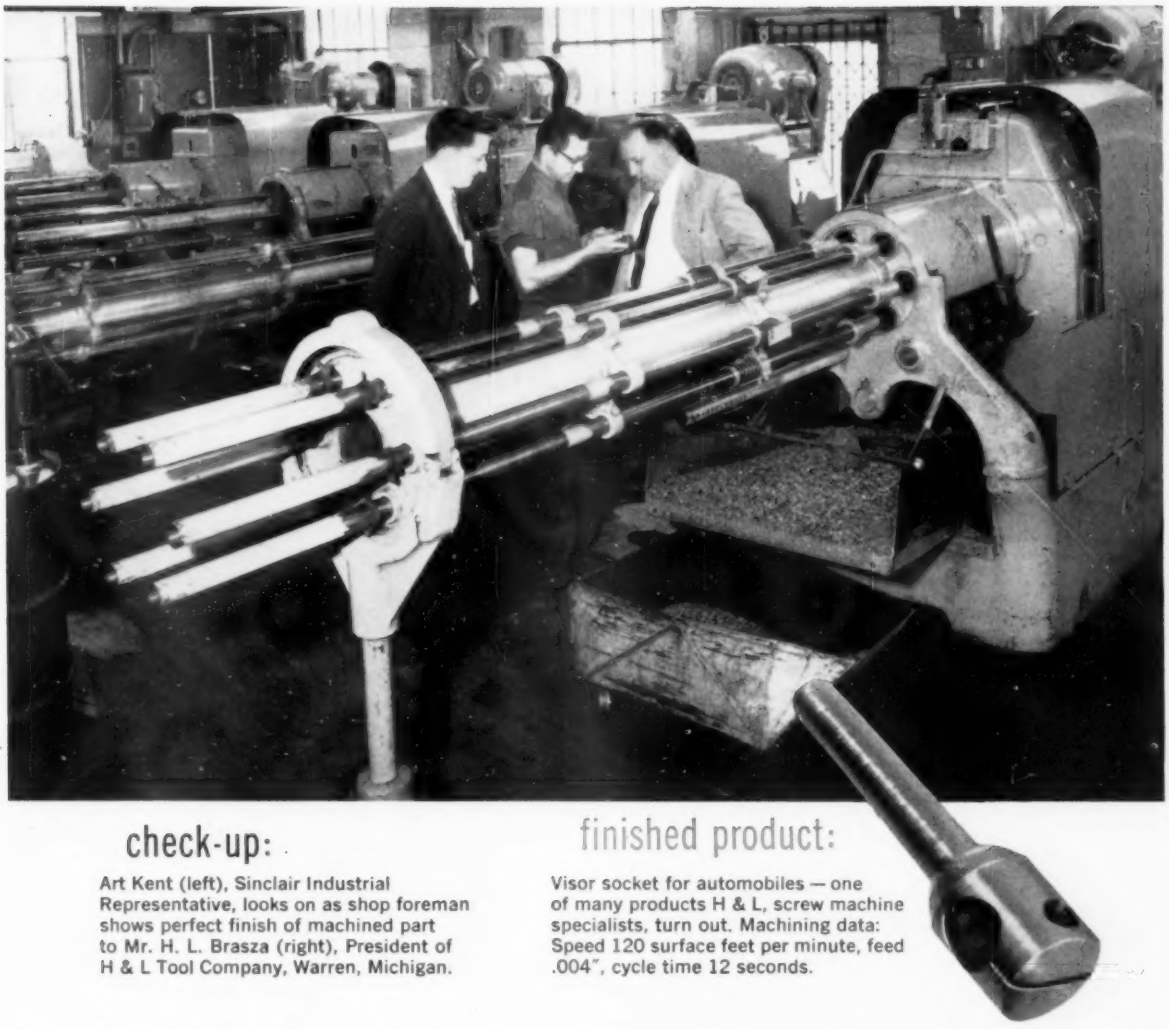

check-up:

Art Kent (left), Sinclair Industrial Representative, looks on as shop foreman shows perfect finish of machined part to Mr. H. L. Brasza (right), President of H & L Tool Company, Warren, Michigan.

finished product:

Visor socket for automobiles — one of many products H & L, screw machine specialists, turn out. Machining data: Speed 120 surface feet per minute, feed .004″, cycle time 12 seconds.

H & L cuts inventory to one cutting oil...CLAIRO® 16

H & L Tool Company started saving money the day they switched to CLAIRO 16, Sinclair's new Cutting Oil. Head man H. L. (Hank) Brasza says: "CLAIRO 16 did away with the need for several different cutting oils."

"CLAIRO 16 is applied to all H & L machining operations for cutting a variety of steels, including the critical types such as #303 Stainless and AISI-4150. CLAIRO 16 makes it possible for us to machine parts manufactured from AISI-1018 cold rolled bar stock most satisfactorily."

Mr. Brasza continues: "We're also very pleased with the excellent tool life and finish we get with CLAIRO 16."

You, too, can benefit from the advantages of CLAIRO 16 Cutting Oil. Contact your local Sinclair Representative or write for free literature to: Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

CUTTING OILS AND COOLANTS

Another Record

BAY STATE
Surface Treatment
RESISTS ABRASION AND LOADING INCREASES PRODUCTIVITY AND LIFE OF TAPS

A surface treatment for taps similar to so-called liquid nitriding is one contributing factor to another Bay State PRECISION PERFORMANCE record.

Highly recommended for tapping Cast Iron and Stainless Steel, Bay State taps with this special surface treatment are effectively used for more efficient tapping of Regular Steel and Sand Cast Aluminum.

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It's ASTE's newest reference book and the FIRST authoritative *practical treatment* on modern practice in the process planning, tool design, equipment, and operations involved in producing structural parts from metal powders.

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Reviewed by Authorities in the Fields of:

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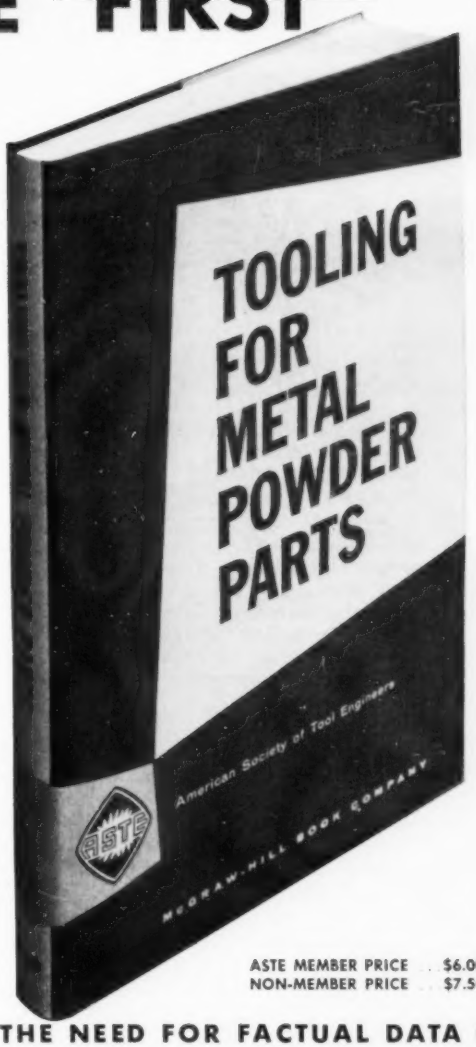
A REFERENCE manual . . . an IDEA stimulator . . . a COMPARISON guide — by GEORGE H. DeGROAT, Associate Editor, *American Machinist*.



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FILLS THE NEED FOR FACTUAL DATA BY:

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PROCESS PLANNERS — to know the conditions that favor selection of the metal powder process as against competitive processes.

TOOL DESIGNERS — who will find new tool design criteria that must be followed.

ALL TOOL ENGINEERS — to show what is needed in equipment, plant, and personnel.

ASTE

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Please send "TOOLING FOR METAL POWDER PARTS" to the address below:

Payment enclosed in the amount of $ ..... Orders shipped to Canada will enter the country duty and tax free. Remittance may be made in Canadian funds at the same prices. Shipments to other countries are subject to import regulations.

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Remittance payable to the Society must accompany order. Do not send currency. Mail this order coupon or a facsimile to: American Society of Tool Engineers, Dept. 3, 10700 Puritan Ave., Detroit 38, Mich.

IMPORTANT—In order to obtain the special, member price of $6.00, orders must be sent to the Society.

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HARDNESS TESTERS

WORLD'S STANDARD OF ACCURACY

ACCO for Better Values

EQUIPMENT for EVERY Hardness Testing Requirement

No matter what your hardness testing requirements are, there's a WILSON "ROCKWELL" instrument to do the job. Choose from this complete selection of hardness testers:

"ROCKWELL"—for most hardness testing functions.

Superficial—for extremely shallow indentations.

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Semi-Automatic (manual feed) and Fully Automatic—for automatically classifying tested pieces as CORRECT, TOO HARD, or TOO SOFT—at test rates up to 1000 pieces per hour.

Special Machines—for testing large objects, obtaining internal readings, and other unusual applications.

ALL WILSON "ROCKWELL" hardness testers provide these advantages:

Accurate performance—precision built, with exact calibration, for consistently correct results.

Long life—durable as a machine tool.

Easy operation—even an unskilled operator can get perfect readings. All controls conveniently grouped.

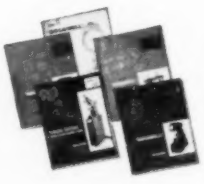
Easy maintenance—interchangeable mechanisms, with spindles mounted on oil-less bearings.

DIAMOND "BRALE" PENETRATORS
for perfect testing every time

A perfect diamond penetrator is essential to accurate hardness testing. Since one point of hardness on the "ROCKWELL" scale represents only 80 millionths of an inch of penetration—only 40 millionths on a Superficial tester—the slightest imperfection will cause a false reading.

Only *perfect* Wilson Diamond Brale Penetrators are sold. Each diamond is flawless, with no chips or cracks. It's cut to an exact shape. Microscopic inspection and a comparator check of every diamond—one at a time—assure this perfection—and assure you of accurate hardness testing every time.

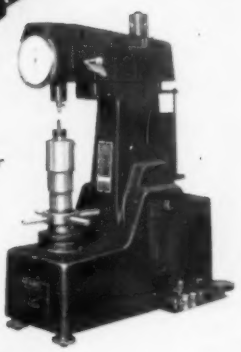
A COMPLETE LIBRARY of Helpful Information



A wide variety of bulletins tells about hardness testing, and describes the many instruments, accessories, and services Wilson offers. Write for your choice:

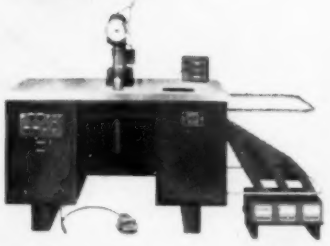
DH-325—WILSON "ROCKWELL" Hardness Testers • **DH-326**—"ROCKWELL" Superficial Hardness Testers • **TT-58**—"ROCKWELL" Twintester • **DH-327**—Special "ROCKWELL" Testers, including Automatic and Semi-Automatic models • **DH-328**—TUKON Tester, for precision MICRO and MACRO testing

"ROCKWELL"



Twintester

Superficial



Automatic

TUKON Tester (for MICRO and MACRO testing)

ACCO **WILSON**

MECHANICAL INSTRUMENT DIVISION
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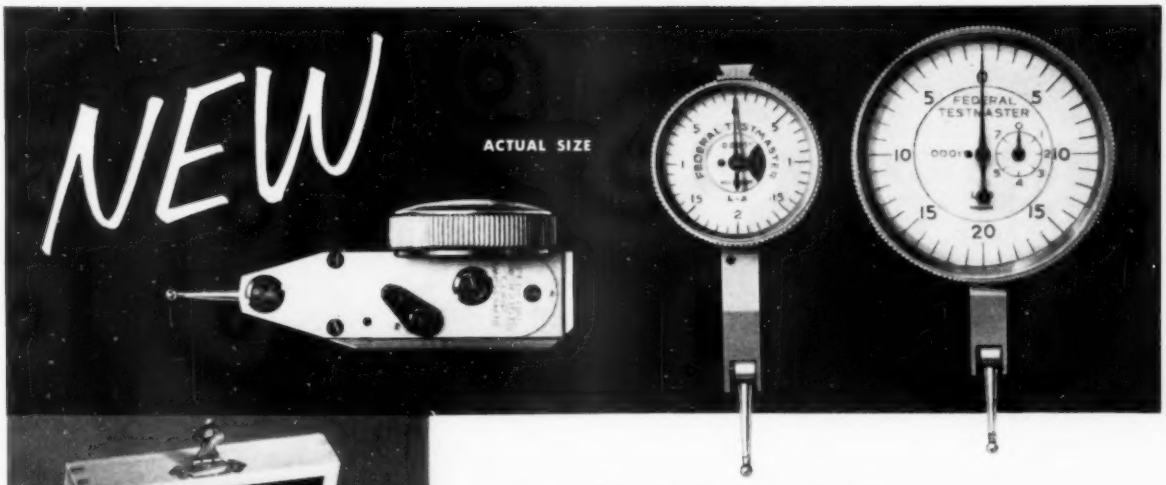
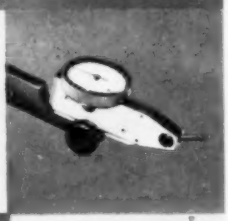
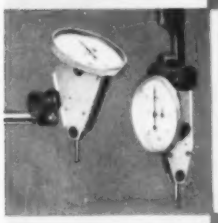


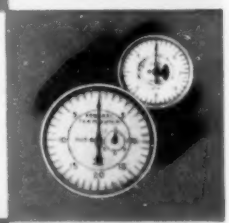
INTEGRAL DOVETAILS make mounting more versatile and secure (An exclusive Federal feature).

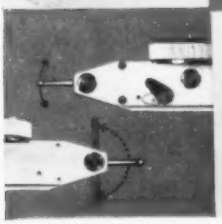




LARGE DIAL MODELS also available in both horizontal and perpendicular styles.

EASY-TO-READ PRECISION DIALS . . . crisp, clear-cut graduations.





CLUTCH-MOUNTED CONTACT (180° rotation) and easy-to-use **REVERSING LEVER.**

The long range, high magnification

FEDERAL TESTMASTER

8 new models made to the highest FEDERAL Standards

Now, the most imitated test indicator of all time . . . the Federal Testmaster, adds eight new models to its Series, all made to the highest Federal standards and all immediately available. These new models, too, will be imitated but never equaled. Beware of look-alikes and imitations.

- These new Federal (Series L) Testmasters have up to *four times the range* you'd expect in a test indicator. The four models with .0005" graduations have .060" range. The other four models (.0001" graduations) have .032" range.
- Despite this longer range, the new .0001" Models have at least *twice the magnification* of other type test indicators. Range per revolution is .004".
- *Even greater magnification* (50% more) if you select the large dial models in this new Testmaster series. They are available in .0001" and .0005" graduations and in regular or perpendicular styles (as are the more compact, smaller dial models).
- Many other features . . . integral dovetails for convenient and positive mounting . . . easy-to-use reversing lever . . . clutch-mounted, interchangeable contact . . . velvet-smooth operation . . . BALL BEARING PIVOTS for low-friction, truly accurate motion transfer.

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FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging

Eventually you'll buy a GORTON MASTERMIL

here's why

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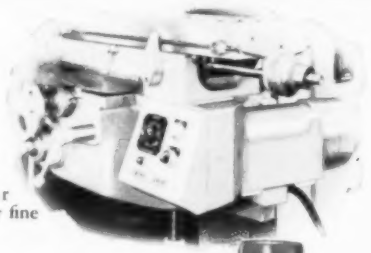
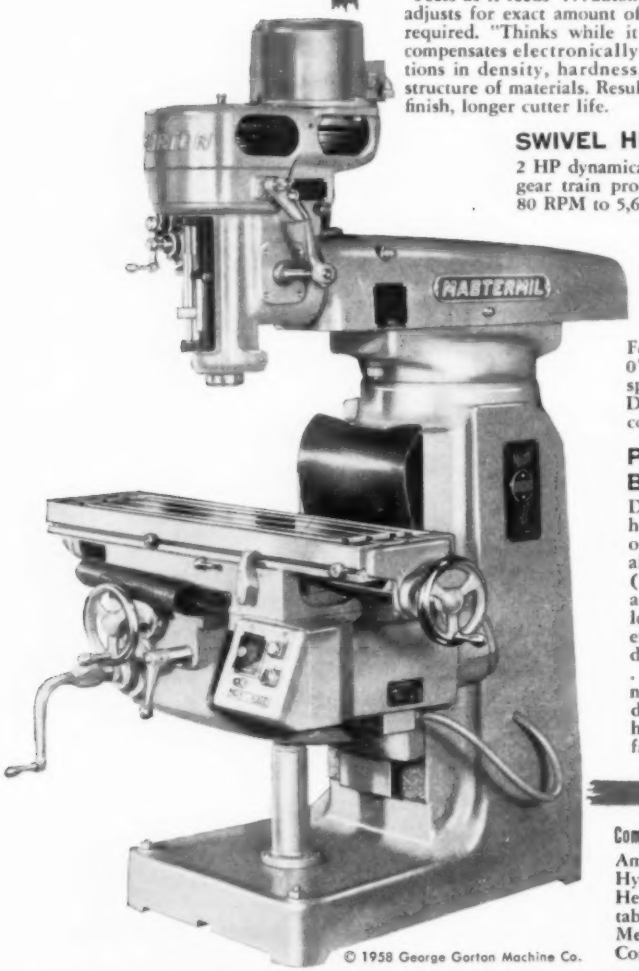
"The Torque-Thinking" Table Feed

"Feels as it feeds"... automatically adjusts for exact amount of torque required. "Thinks while it works", compensates electronically for variations in density, hardness, molecular structure of materials. Result: Superbly fine finish, longer cutter life.





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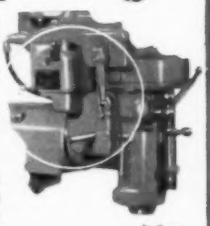
SWIVEL HEAD

2 HP dynamically balanced motor with belt and gear train provides wide range of speeds from 80 RPM to 5,600 RPM. Head swivels 90° left or right, head, ram and turret rotate 180°. Cross movement 14 inches. Push button starting.

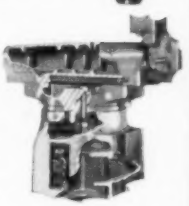
DOWN FEED INFINITELY VARIABLE

Feeds may be varied infinitely from 0" to 5" independent of spindle speeds. High efficiency belt drive. Direction and rate of feed separately controlled.



PERMANENT ACCURACY BUILT-IN

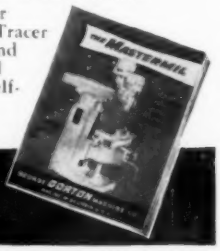
Distortion is prevented by extra heavy one-piece column cast with over-size ribbing . . . extra heavy alloy steel turret clamping bolt (1⅜" dia) with 3-point clamping action . . . heavy dovetail way full length of vertical column face . . . extra large table, knee and 24" saddle (2" longer than table travel) . . . square lock bearings with long, narrow guide between knee and saddle . . . positive locks . . . extra heavy feed screws . . . bearing surfaces hand-scraped.



Complete Versatility Through Attachments Built-In or Field Installed.

Among such equipment is, Trace-Master Hydraulic Tracer Control, Duplicator Tracer Head and/or Table with base, saddle and table in one unit, 6" Raising Block, End Measuring Rods and Dial Indicators, Self-Contained Coolant System.

Write for Bulletin 2699-2610



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GEORGE GORTON MACHINE CO.

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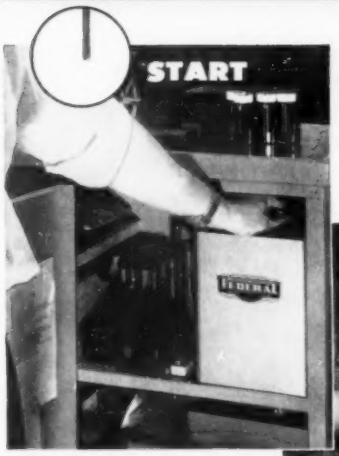
Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

A8-1008R

NEW EASE IN ELECTRONIC GAGING



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*By Actual Test

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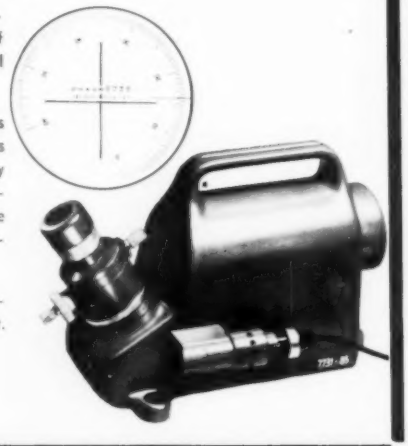

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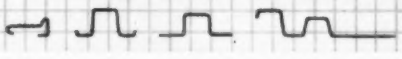

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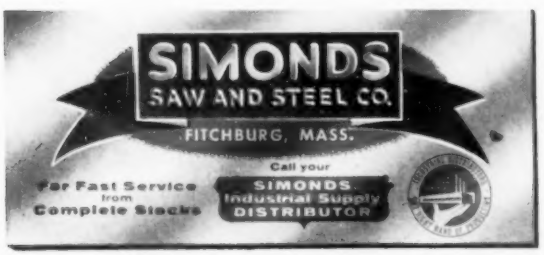

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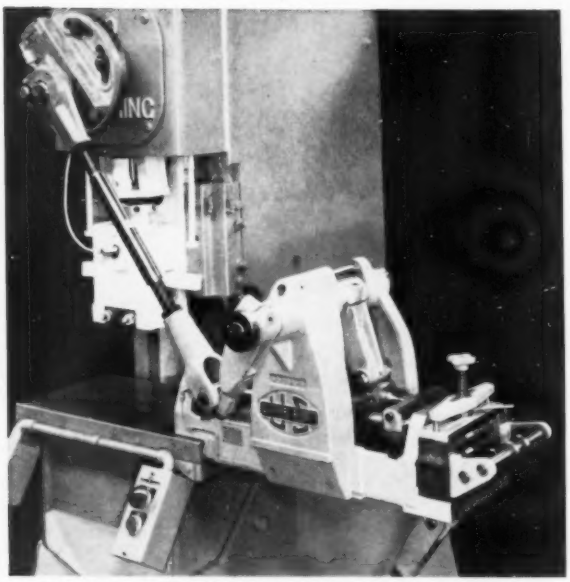

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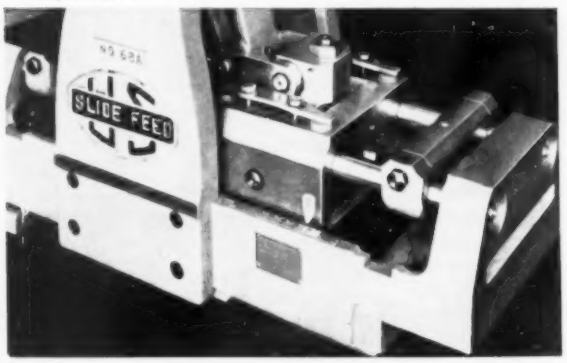

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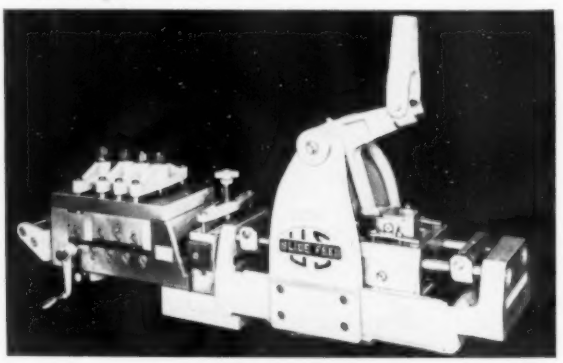

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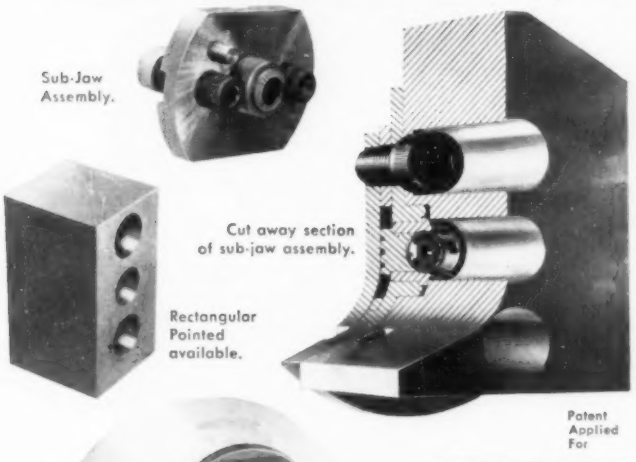

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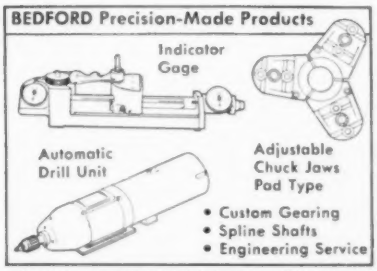

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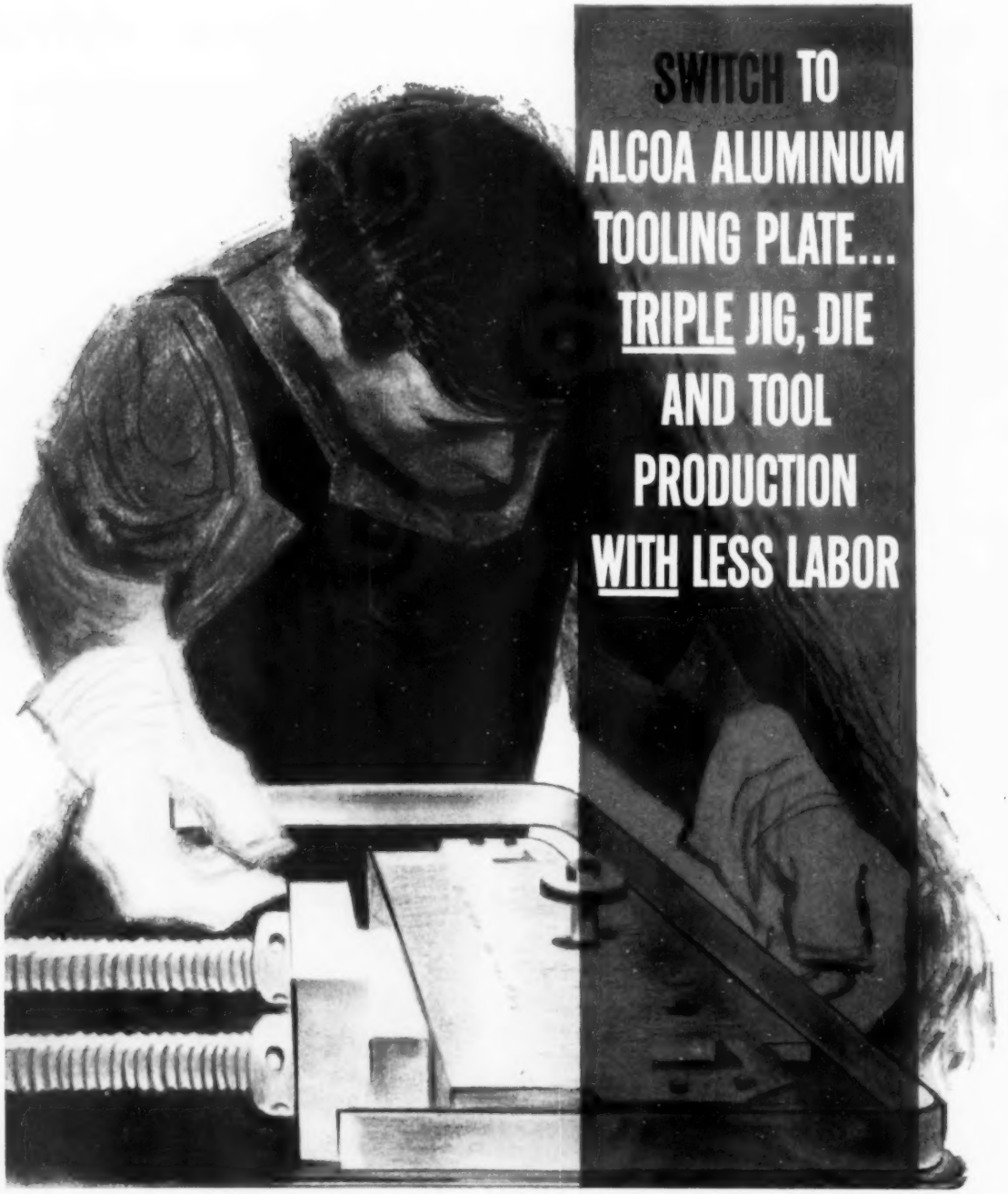

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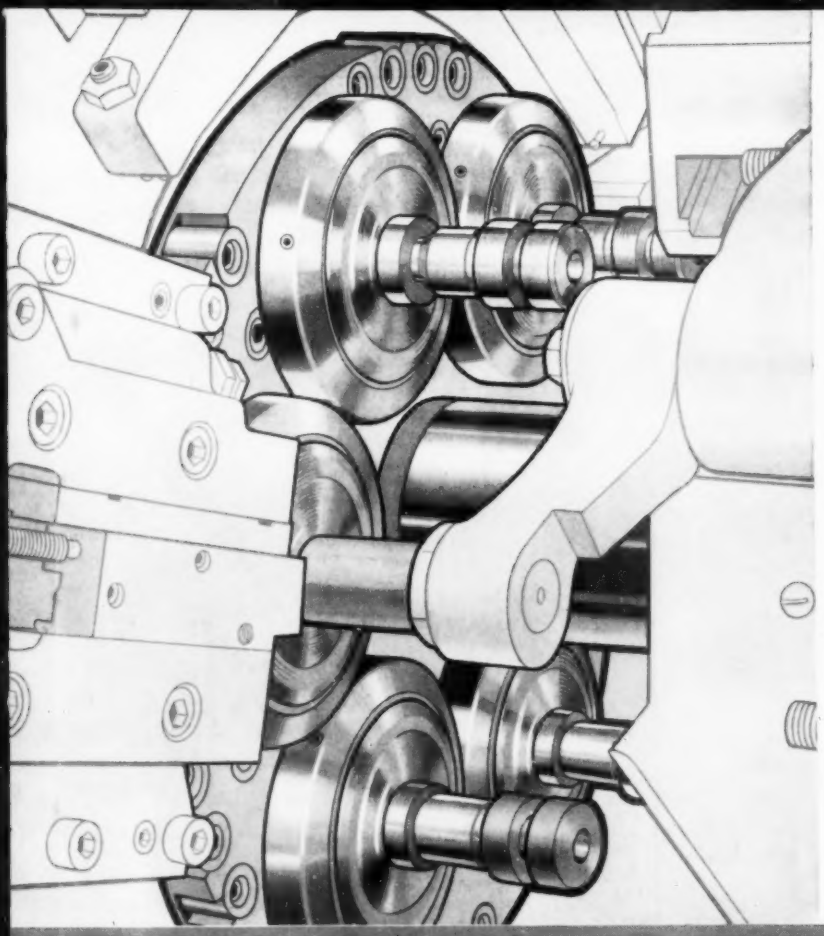

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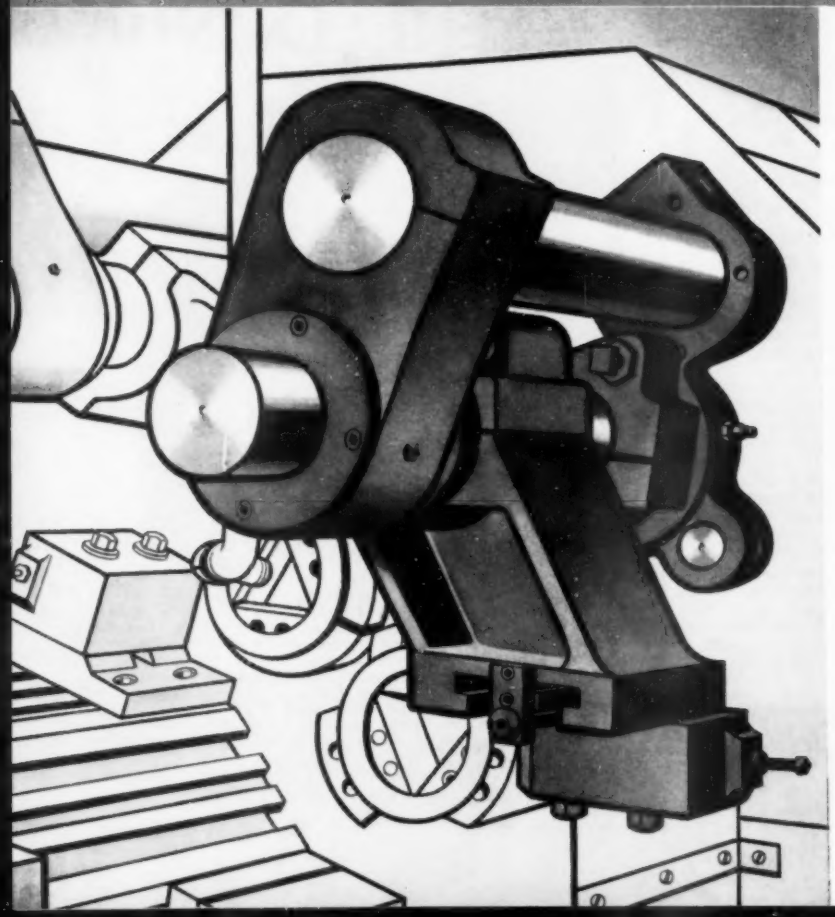

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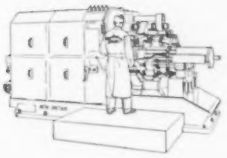

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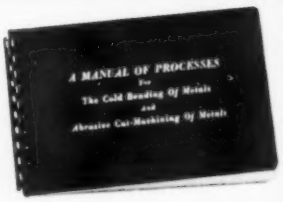

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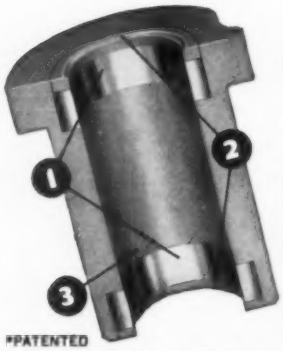

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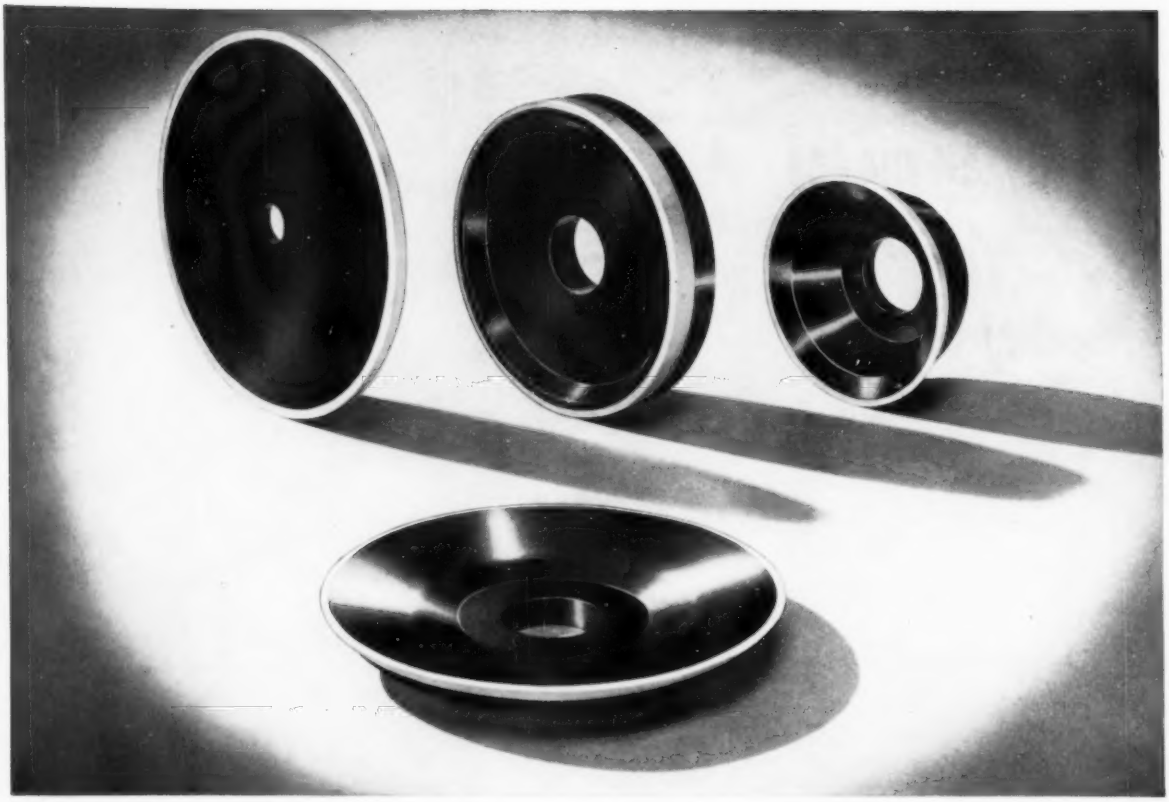

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The set includes all papers for which manuscripts were received in time for preprinting. A complete list of the individual papers scheduled to be presented is given below:

Title	Paper No.
Honeycomb Sandwich Fixtures at 2000°F.	132
Construction for Multi-Curved Parts	133
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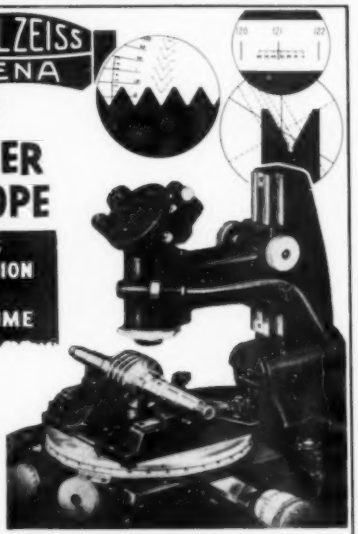

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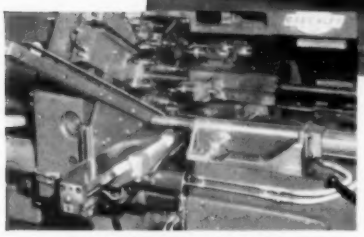

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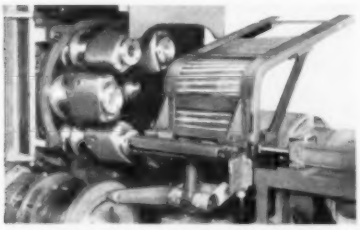

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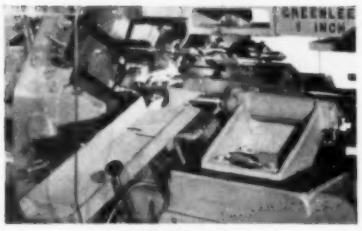

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October 1958

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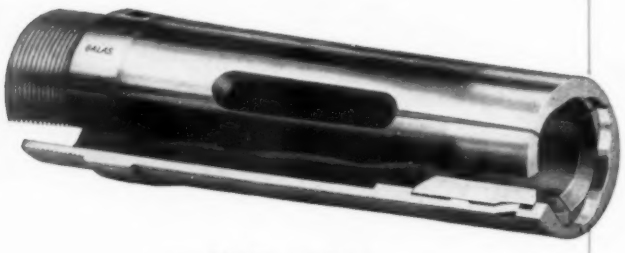

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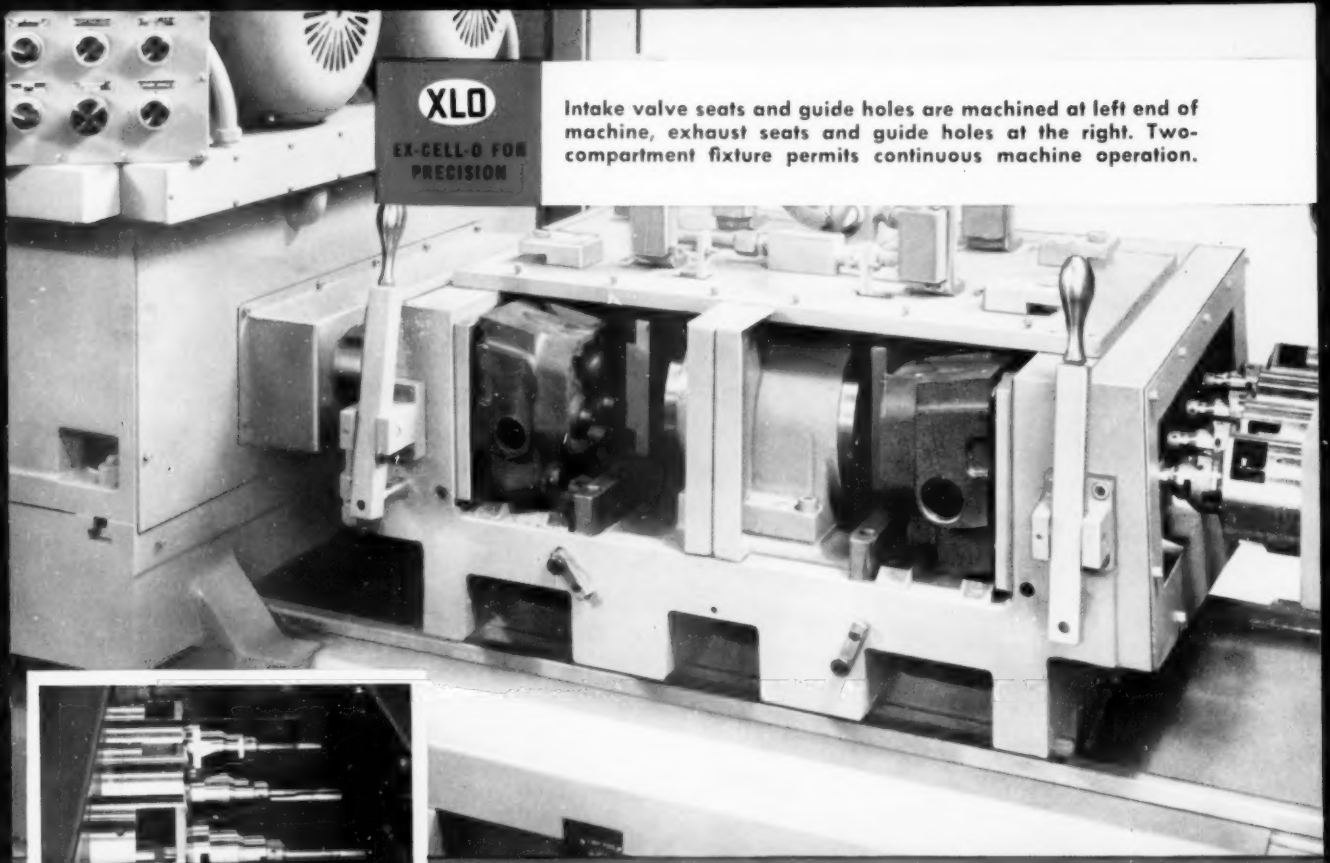
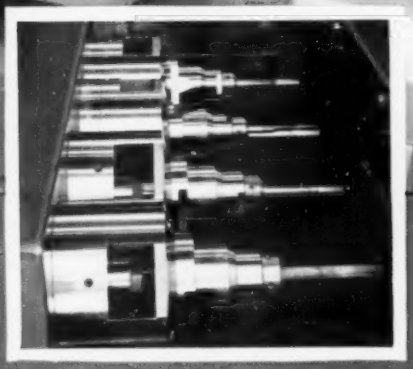
Intake valve seats and guide holes are machined at left end of machine, exhaust seats and guide holes at the right. Two-compartment fixture permits continuous machine operation.





Gun-type drills extend through spindle centers and retract automatically

CONCENTRICITY GUARANTEED

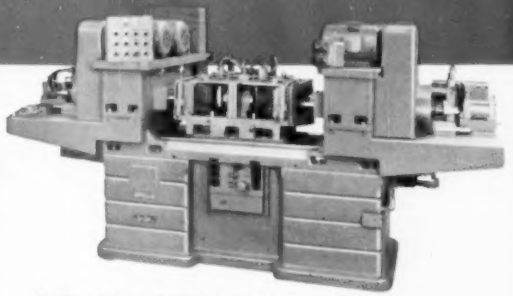
58-10

Bor-Drils valve guide holes and plunge-faces valve seats in one operation

A Standard Ex-Cell-O 17-A Precision Boring Machine, equipped for the Bor-Dril process, is turning out 23 cylinder heads per hour for a large auto manufacturer.

The table rapid-traverse feeds cylinder heads to the left into four cutters that plunge-face intake valve seats, then retract .020". Next, four gun-type drills advance through the spindle shafts to Bor-Dril guide holes from the solid—with guaranteed concentricity. The table then moves to the right, repeating the process on exhaust valve seats and guide holes.

Find out how the Bor-Dril process can help speed production in your plant; contact your local Ex-Cell-O Representative, or write direct.



Style 17-A Precision Boring Machine equipped for Bor-Dril process drills deep holes from the solid with guaranteed accuracy.

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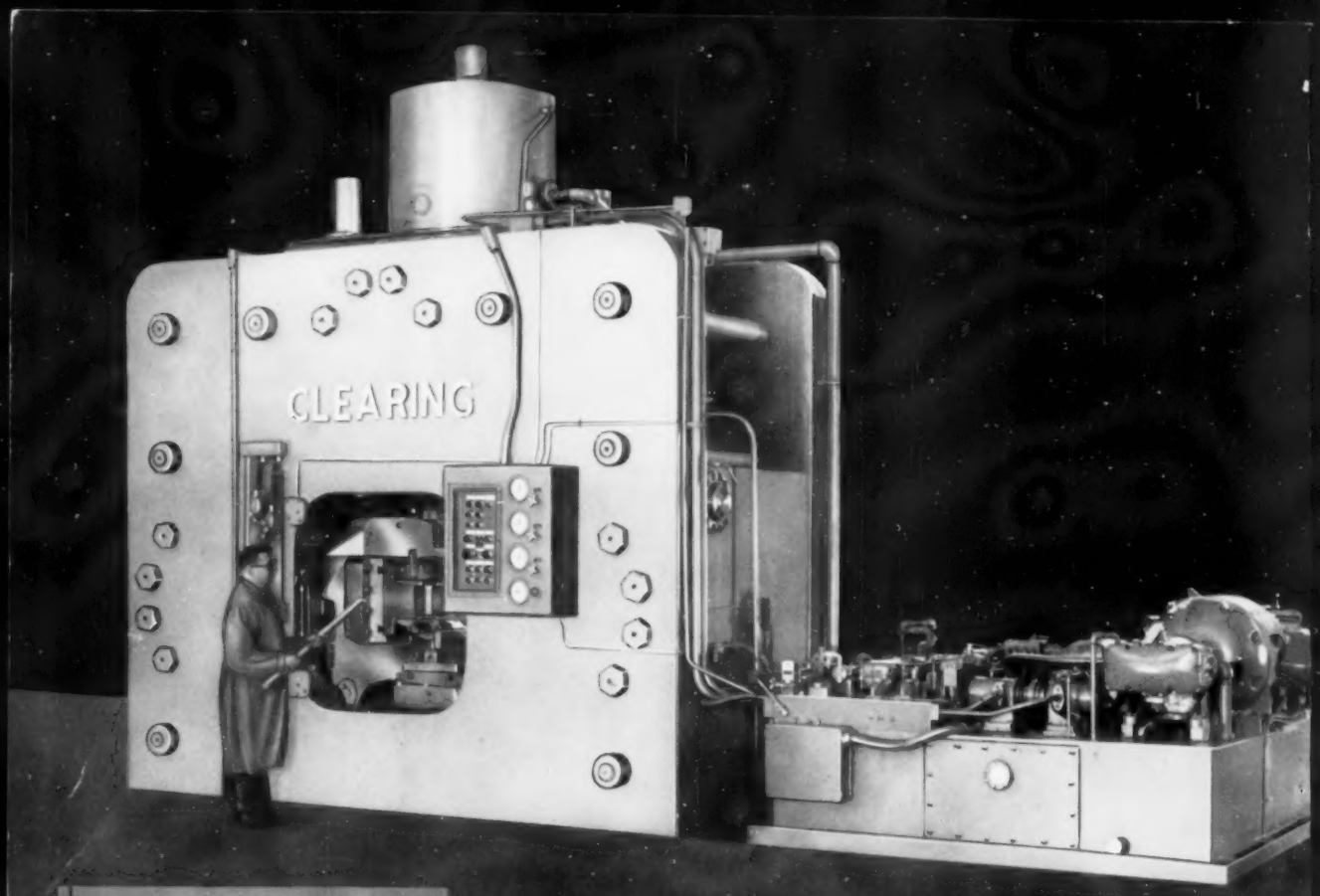

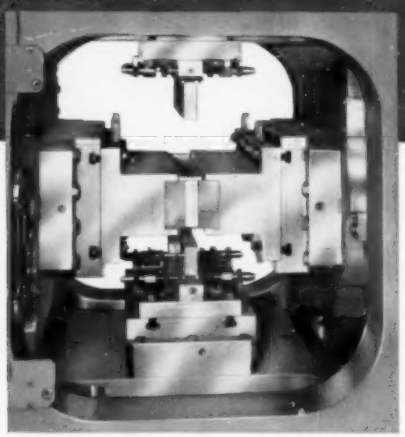

Close-up of the die area showing the four slides in operation. The right and left slides have come together. The top and bottom slides will close slightly more, then stop as the bottom slide forms a 5-sided cavity between the horizontal slides. Powdered metal is then poured into the cavity, the press continues the stroke and the briquette is formed.

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with a 3,000 ton squeeze

4-way pressure from a Clearing hydraulic produces briquettes of *"missile metals"

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